9.0 DATA QUALITY ASSESSMENT AND ANALYSIS

Several levels of data review and screening are used to characterize the quality of the data. The procedures used to characterize the data were changed in mid 1999 when the use of a computerized information management system was initiated; the "Bechtel Environmental Integrated Data Management System" (BEIDMS). Prior to this change, the data were received from the laboratory as an American Standard Code for information Interchange (ASCII) file containing 33 fields of data variables that describe a sample and the analyses performed on that sample. There was one line of data for each sample submitted to the laboratory and one file for each type of sample and analysis; for example, there is a file for gross alpha in air. These files were received monthly or quarterly depending upon the frequency of sample collection. After the use of BEIDMS was initiated, the data were still received as an ASCII file, but the format and content of the file changed.

During the first half of 1999, the files received from the laboratory were screened by a data validation computer program that runs on a personal computer. This program has 15 modules, one for each type of sample and analysis. The modules subjected each line of data to between 6 and 14 checks of data values. A line of data that failed a check was copied to an output file with a notation identifying the check that failed. All modules check for valid sampling location names and identification numbers. Result values, error values, minimum detectable concentrations (MDCs), and sample volumes or weights were checked to determine if they fall within expected ranges of values. The modules also counted the number of samples in the file for each sampling location and compared this count to the number of sample records that should be in the file. The output files were reviewed by the sampling manager and appropriate actions were taken. The actions taken include correcting the data entries and calculations, submitting samples for reanalysis, collecting additional samples to verify unexpected conditions, and inspection and repair of sampling apparatus.

After the use of BEIDMS commenced, an interface program was used to enter the data into BEIDMS from the ASCII file received from the laboratory. Files of Structured Query Language (SQL) statements are used within BEIDMS to perform most of the data validation checks that the 15 module data validation program performed. The use of the modular program was discontinued. The output from the SQL files was used in the same way as the output of the modular validation program. Corrections are made to the data within BEIDMS. The data are periodically exported from BEIDMS into a spreadsheet program on a personal computer. The data copied to the spreadsheet are combined into monthly, quarterly, or annual files, and submitted for statistical review. Most data files are reviewed statistically when the data for a full quarter of a year are available. The statistical review looks for trends in the data, outliers, clustering of data values, and consistency with historical levels. Descriptive statistics and plots of the data are provided for management review.

All data for a year are available at about the end of the first quarter of the next year. The data are archived in BEIDMS and prepared for inclusion in the annual report. An extensive statistical analysis of each data set is performed and these analyses are summarized in this chapter of the annual report.

9.1 AIR SAMPLE DATA

GROSS ALPHA IN AIR

In 1999, 1441 weekly gross alpha in air samples and duplicates from 29 locations on the Nevada Test Site (NTS) and Nellis Air Force Range (NAFR) were collected and analyzed. Descriptive statistics for the results and duplicates from individual sampling locations are given in Table 9.1. The median MDC for 1999 was 1.85×10^{-15} µCi/mL for the NTS locations and 47 percent of the results and duplicates were less than their individual MDCs. 9.1 is a time series plot of all data values from 1999. This plot indicated a slight trend of increasing values over the entire year, starting at an average value of about 1.6×10^{-15} µCi/mL and ending at an average value of about 4.0×10^{-15} µCi/mL. This plot also showed that most of the data values were between 0 and 5×10^{-15} µCi/mL, with a few higher values. The highest values are from samples collected at Bunker 9-300.

A one-way analysis of variance (ANOVA) on the square root of the data (the square root of the gross alpha in air data has a normal statistical distribution) versus sampling location found a significant difference among sampling locations. An examination of location mean values using Tukey's pairwise comparisons to adjust for simultaneous inferences found two clusters of mean values; Bunker 9-300 formed one cluster and all the remaining locations formed the second cluster. The mean gross alpha level at Bunker 9-300 in 1999 is 4.64×10^{-15} µCi/mL and the mean for all the other locations combined is 2.35×10^{-15} µCi/mL.

Gross alpha in air data have been collected since the middle of 1996. Three and one-half years of data are insufficient for an analysis of historical trends, however a few observations about short term trends can be made. Data are available from 25 sampling locations on the NTS used in 1999. Of these, 14 have data for the three and one-half years that gross alpha in air has been measured. Figure 9.2 presents boxplots of the available gross alpha historical data. The 1999 gross alpha activities are higher than the 1998 activities at all locations except one (Radioactive Waste Management Site Area 9 [RWMS 9] south). The 1999 alpha activities are also higher than the 1997 activities at all locations. The general pattern over the years in gross alpha in air activities is a decrease from 1996 to 1997, then successive increases from 1997 to 1998 and from 1998 to 1999. The annual averages for all locations on the NTS for 1996 (six months of data), 1997, 1998, and 1999 are: 2.14, 1.72, 1.78, and 2.39 µCi/mL $\times 10^{-15}$ respectively.

GROSS BETA IN AIR

Gross beta is analyzed on the same glass-fiber filters that are used for gross alpha analysis. In 1999, 1,441 gross beta samples and duplicates were analyzed. Descriptive statistics for each sampling location are given in Table 9.2. The median MDC for 1999 was 4.04×10^{-15} µCi/mL for the NTS locations and only one of the 1,441 results and duplicates were less than their individual MDCs (E-MAD north for the sample beginning on June 1, the MDC was high because of low sample volume due to a power outage).

The sampling dates were grouped by the month that sampling began, and then a two-way ANOVA was performed to test for significant differences among months and among sampling locations. This statistical test found significant differences for both factors. The differences between months indicates that there was a statistically significant trend within 1999.

Figure 9.3 is a time series plot of all the gross beta results by sample week. The solid line in this figure is a "locally weighted scatter plot smoother line," which is a statistical tool for visualizing any trend that may be in the data. This line appears to

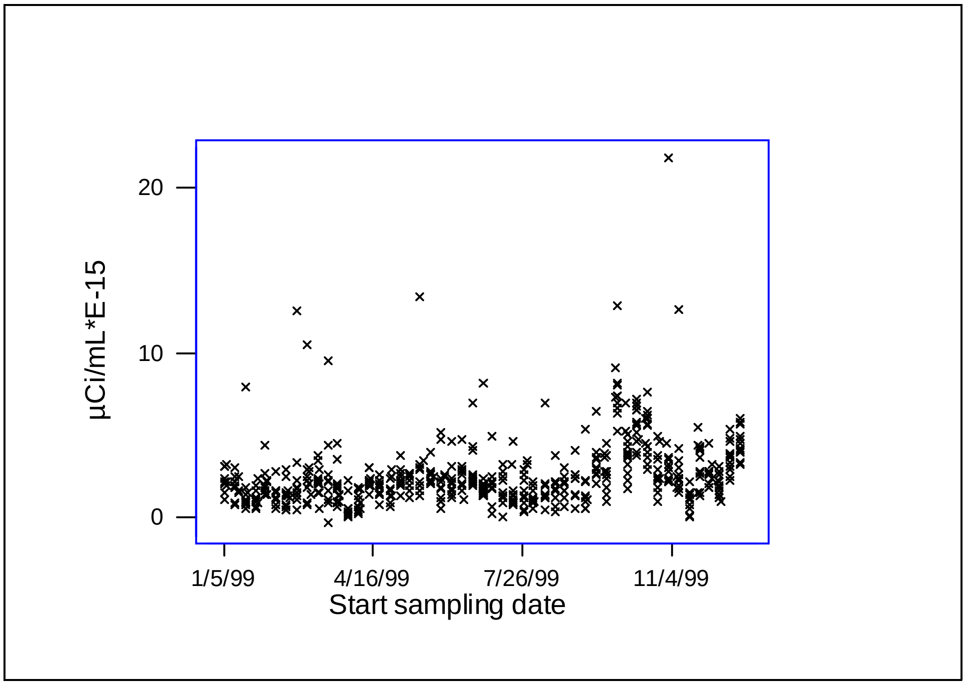

Figure 9.1 Time Series Plot of 1999 Gross Alpha in Air Results

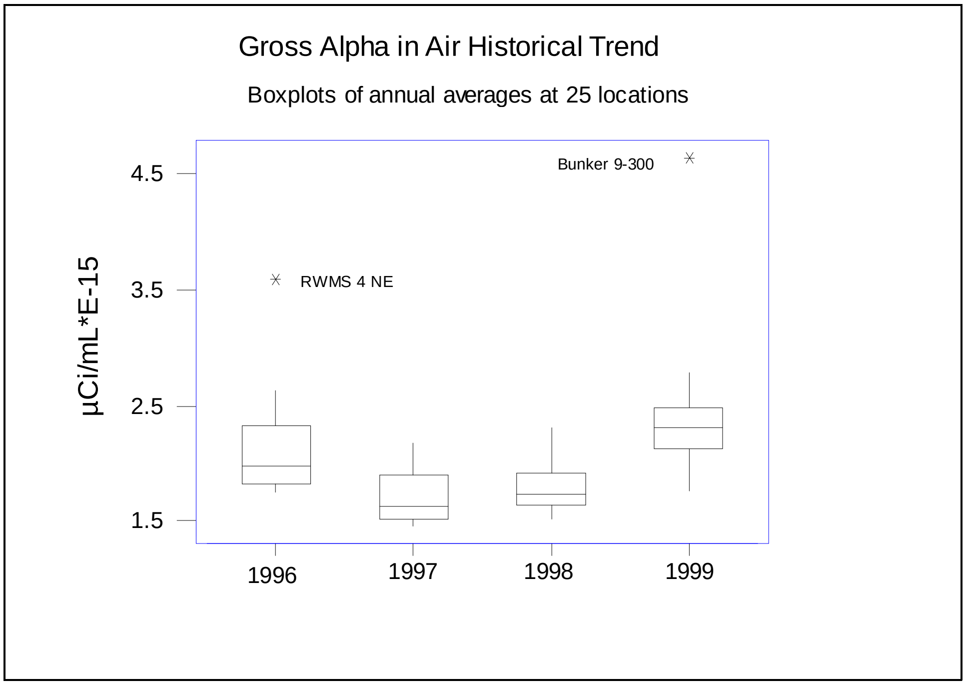

Figure 9.2 Boxplot of Historical Gross Alpha Annual Averages

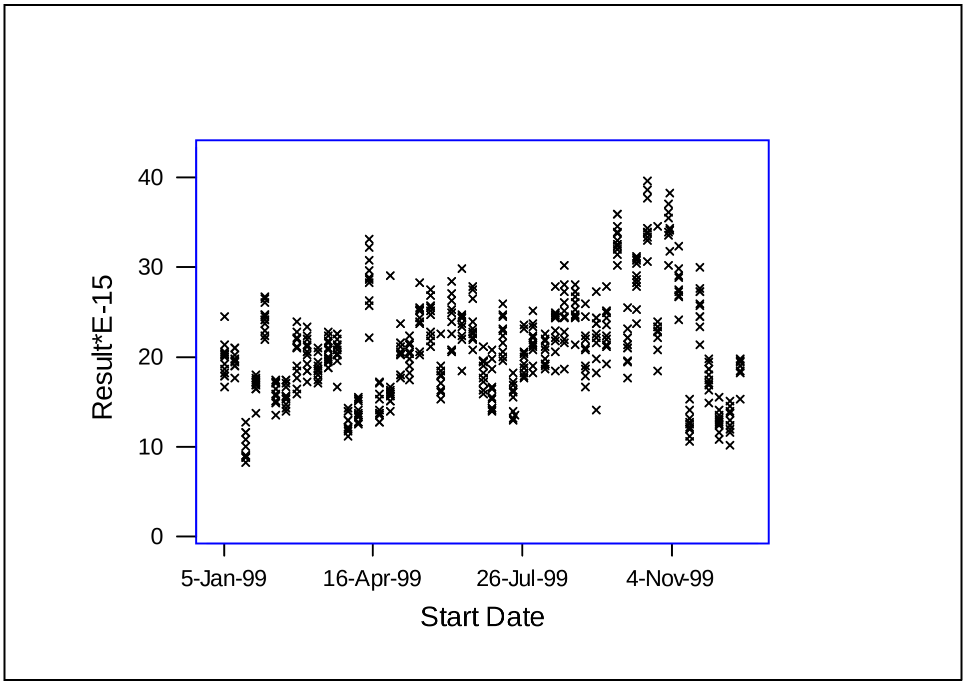

Figure 9.3 Time Series Plot of 1999 Gross Beta in Air Results

show a trend with increasing gross beta levels from January to mid October and then a decreasing trend.

The two-way ANOVA also found statistically significant differences between sampling locations. The sampling location means were examined for any clustering of values, and no clusters were found. There is a pattern of gradually increasing mean values from the lowest mean at RWMS 9 south to the highest mean at RWMS Transuranic Building north. A Tukey's simultaneous test for differences between locations found only that the two highest location means are significantly different from the two lowest location means.

In previous annual reports historical trend was analyzed using data from three sampling locations that had been in continuous use since 1966 and two locations that had been in continuous use since 1997. These five locations are the Area 2 Complex, Well 5B in Area 5, CP-6 in Area 6, Gate 700 south in Area 10, and Gate 293 in Area 11. Sampling at all five historical data locations was terminated in late 1998. In order to continue monitoring historical trend it is necessary to choose new sampling locations or choose a different method of analyzing historical trend. Four new "historical data" locations were chosen: three are close to historical locations that were terminated and one is in the middle of Yucca Flat. The 2-1 Substation in Area 2 was chosen as a replacement for the Area 2 Complex location. The substation is slightly less than two miles southeast of the complex and in similar geography. Data are available from the substation from 1988 to the present. The Yucca Complex location in Area 6 was chosen as a replacement for the CP-6 location. The complex is less than a mile northeast of CP-6 and about 600 feet lower in altitude than CP-6. Data are available from the complex from 1973 to the present. The EPA Farm in Area 15 was chosen as a replacement for the Gate 700 south location. The farm is less than two miles northwest of the gate and in similar geography. Data are available from the farm from 1979 to the present. Finally, the BJY location was chosen because it is close to the middle of Yucca Flat. BJY is about one-half mile south of the junction of Areas 1, 3,4, and 7. Data are available from BJY from 1979 to the present.

Figure 9.4 is a time series plot of the annual averages from the five "former" locations plus the four "replacement" locations. The line in Figure 9.4 suggests a trend peaking in 1971, then a steady decrease in annual averages until 1975. The downward trend resumes in 1978 and continues until about 1983 when a level of about 20 × 10^{-15} µCi/mL was reached. Since 1982, the annual averages have remained at or slightly less than the 20 × 10^{-15} µCi/mL level, except for the peak in 1986. Three additional peaks are seen in Figure 9.4 that occur before 1982. A significant peak occurred in 1971 which was probably due to the BANEBERRY test that accidently vented following detonation on December 18, 1970. This test was located in the southwest section of Area 8. Peaks occurred in 1977 and 1981, which are probably due to foreign nuclear testing. The peak in 1986 is attributed to the accident at Chernobyl.

Since about 1982, gross beta in air levels have been uniformly low and essentially at world-wide background, except for the 1986 peak. Almost all values are above analytic MDCs; thus, the data values are valid measures of environmental conditions.

PLUTONIUM IN AIR

The glass-fiber filters that were used for weekly gross alpha and beta analysis and gamma spectroscopy were composited on a monthly basis and then analyzed for ^{238}Pu and $^{239+240}$Pu. Descriptive statistics for the results and duplicates from individual sampling locations are given in Table 9.3 for ^{238}Pu and in Table 9.4 for $^{239+240}$Pu. The median onsite MDC for ^{238}Pu in 1999 was 10.15 × 10^{-18} µCi/mL. Ninety-six percent of the onsite results were less than the MDC, and 57 percent were negative. The median onsite MDC for $^{239+240}$Pu was 10.05 × 10^{-18} µCI/mL. Nine percent of the onsite results were negative, and 51 percent were less than the MDC.

Probability plotting of the ^{238}Pu data indicated that the negative data are from a different statistical distribution than the positive data, and the positive data have a lognormal statistical distribution. Because of

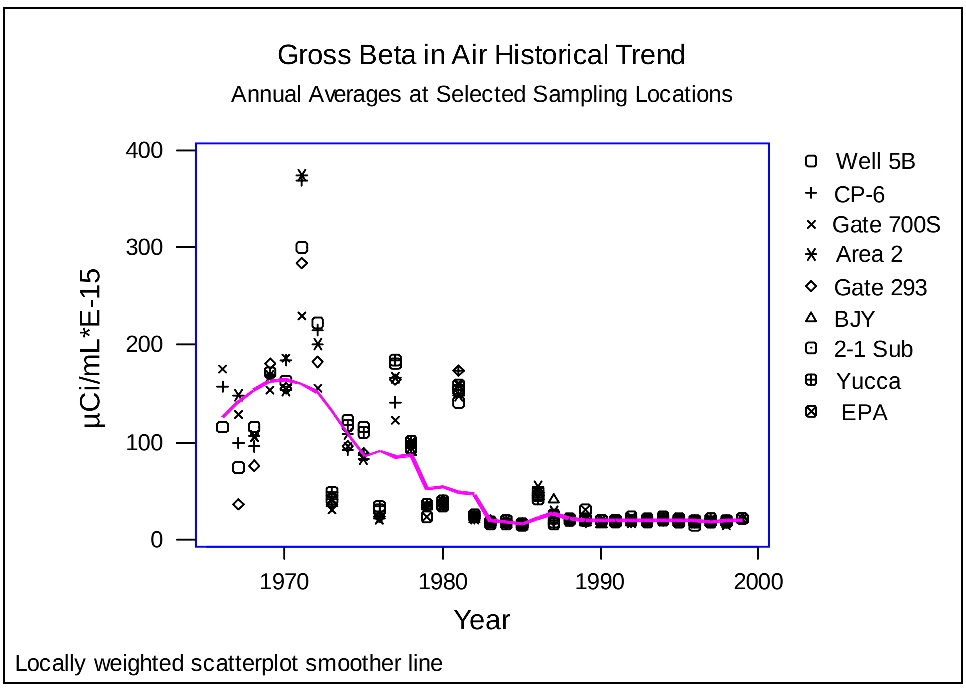

Figure 9.4 Historical Time Series for Selected Sampling Locations

this, and that almost all results are less than the MDC, only a few summary statistics were done for this isotope.

Those sampling locations that have ^{238}Pu concentrations above the MDC are typically locations that have historically shown relatively high concentrations. Bunker T-4 in Area 4 had above MDC results in July, August, and December 1999. This bunker is about 200 feet southwest of the T-4 tower location. Four atmospheric tests were conducted at this tower location in the 1950's: FOX on May 25, 1952, NANCY on March 24, 1953, APPLE-1 on March 29, 1955, and KEPLER on July 24, 1957. The 9-300 Bunker in Area 9 had above MDC results in February and April through November. This bunker is surrounded by 15 nuclear test locations. The closest two are approximately 500 feet northwest of the bunker and were underground tests: MANATEE on December 14, 1962, and APSHAPA on June 6, 1963. The other sample, with above MDC results, was collected at the RWMS 4 northeast sampling location in Area 5 in January 1999. This location has no history of high values.

Descriptive statistics for $^{239+240}Pu$ by sampling location are given in Table 9.4. The most striking features of this table are the great differences between the means and corresponding medians, large standard deviations, and relatively high maximum values. This pattern of statistics is characteristic of extremely skewed data. Probability plots of these data indicated a mixture of two statistical distributions. The data above zero have nearly a lognormal distribution and the data below equal to and below zero have an undetermined distribution. An examination of the data in the probability plots showed that the 12 highest values were from samples collected at the 9-300 Bunker.

The significance of the differences in $^{239+240}Pu$ concentrations among NTS operational areas can be assessed using ANOVA procedures. A one-way ANOVA was performed on the logarithms of the data; logarithms delete the negative data values. This analysis showed very significant differences among areas. The $^{239+240}Pu$ concentrations in Area 9 are significantly higher than all other areas. Area 9 contains one sampling location, the Bunker 9-300 location. The remaining areas can be arranged into several overlapping groups with no obvious clusters of mean values.

Plutonium in air data were first reported in the 1971 Annual Report. From 1971 to 1989 no distinction was made between ^{238}Pu and $^{239+240}Pu$, but it is known from the analytical method used that $^{239+240}Pu$ was being measured. In 1989, ^{238}Pu analyses began. Figures 9.5 and 9.6 plot historical annual averages from the four sampling locations that have data available from 1989 through 1999. Figure 9.5, containing ^{238}Pu annual averages, shows an exponential shaped decline from a level of about 6×10^{-18} µCi/mL in 1989 to almost zero in 1999. Figure 9.6, containing $^{239+240}Pu$ annual averages, indicates an almost constant trend over the entire time period of the figure. The highest value in Figure 9.6 is 150×10^{-18} µCi/mL, and the public derived concentration guide (DCG) is over 13 times higher at 2×10^{-15} µCi/mL.

TRITIUM IN AIR

Fourteen samplers for airborne tritiated water vapor were placed at locations on the NTS during 1999. In September, tritium sampling began at two offsite locations: Indian Springs High School and Amargosa Valley Community Center. Samples were typically collected over a two week period. Figure 4.1 shows the locations of the 1999 tritium in air sampling locations on a map of the NTS.

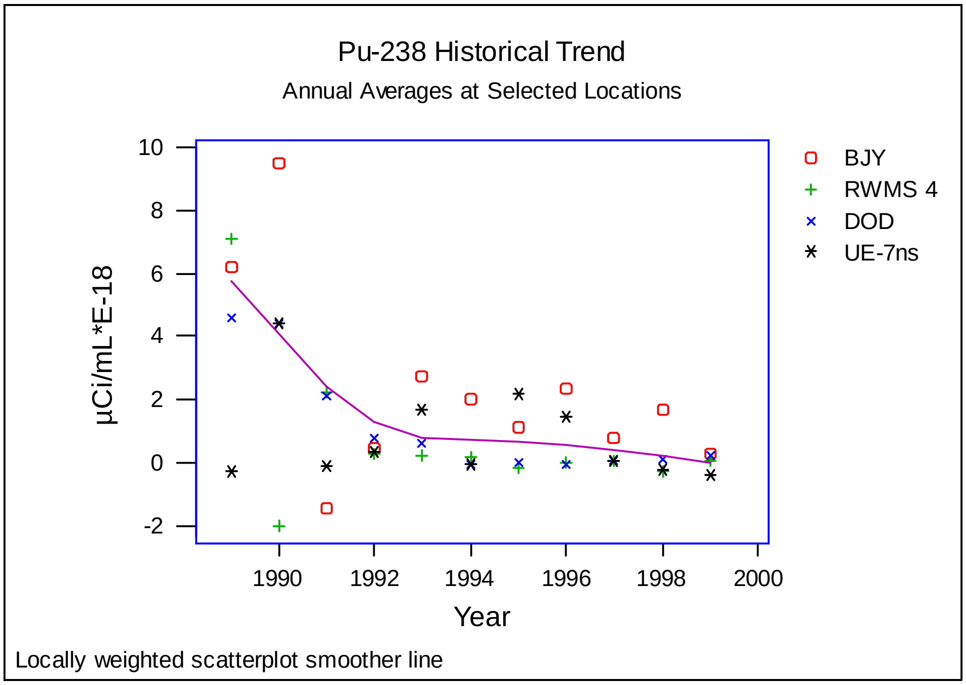

Figure 9.5 Time Series Plot of ^{238}Pu Annual Averages

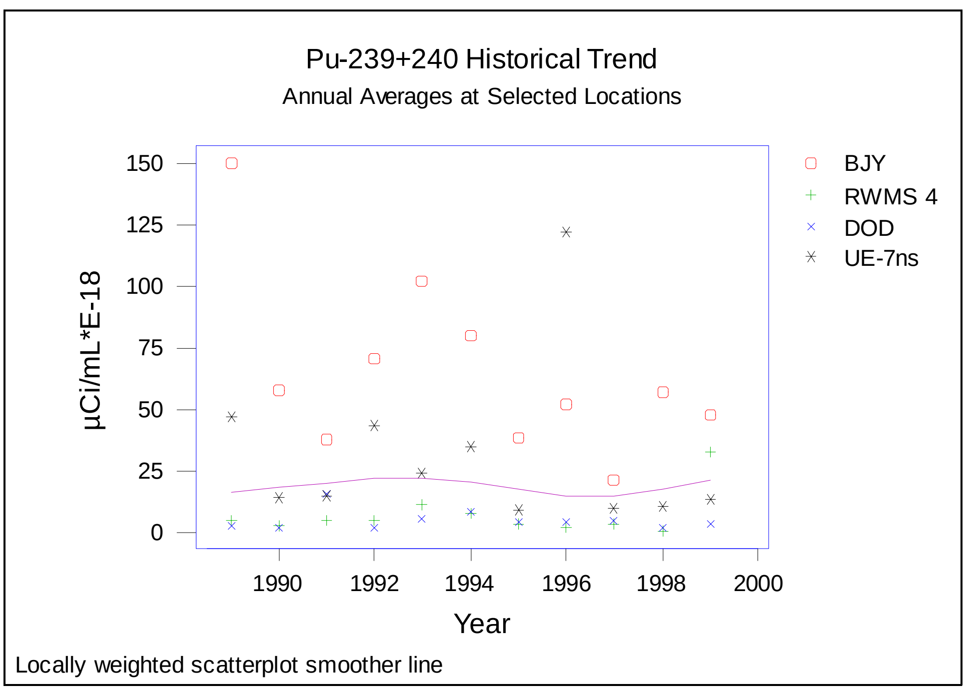

Figure 9.6 Time Series Plot of $^{239+240}$Pu Annual Averages

Table 9.5 gives descriptive statistics for the results and duplicates from the individual sampling locations. Note that the units used in this table differ from those used in all previous tables. Forty-six percent of the data values are below the individual MDCs, and 10 percent are negative. Most of the above MDC results are from the Greater Confinement Disposal (GCD) trailer, Building 5-6 of the RWMS, EPA Farm, SEDAN north, E Tunnel, and SCHOONER locations. The RWMS has storage for tritiated waste as well as other radiological waste materials. The EPA Farm is close to SEDAN north, which is a known source of low levels of tritium. Note that there are only three samples from the decontamination pad. The waste material stored at this pad was relocated at the beginning of 1999 and the decontamination facility was decommissioned.

Figure 9.7 is a time series plot of all the onsite tritium in air data for 1999. The high values seen during the summer months are from the SCHOONER sampling location. Historically, most tritium in air sampling locations have shown increased tritium levels during the hot summer months, and this pattern is most obvious in the SCHOONER data. The highest value in Figure 9.7 is from the BJY location. A review of the data suggest that for the sampling period beginning on September 7, 1999, the samples or data for BJY and SCHOONER were interchanged. No evidence of this could be found in the log books or other records, but for the statistical analyses reported here, the interchange was assumed to have occurred.

In Table 9.5, note that most of the medians are smaller than the corresponding means. This is characteristic of data that has a lognormal statistical distribution. Probability plots of the tritium in air data indicated that these data have a lognormal statistical distribution. A logarithmic data transformation will cause the higher values in Figure 9.7 to appear less remarkable. This transformation will also discard all negative data values; however, only 10 percent of these data are negative, and this is not a serious loss of information. A one-way ANOVA on the logarithms of these data indicated a significant difference among sampling locations. This analysis identified three groupings of sampling locations based on 1999 tritium in air levels. The group with the lowest tritium levels has data values that were usually less than the MDC. This group includes Stake T-18, Well 5B, BJY, the Waste Examination Facility (WEF) northeast, RWMS west, and RWMS south. The second group contains five sampling locations: RWMS GCD Trailer, Building 5-6, SEDAN north, E Tunnel pond, and the EPA Farm. This group contains tritium levels that are above MDC during the summer months. The final group contains a single location and is significantly different from all other groups, the SCHOONER location.

There are five locations that have been in continuous use since 1982 when tritium in atmospheric moisture data first appeared in NTS annual reports. These locations are: BJY, EPA Farm, RWMS 4 northeast, RWMS 7 west, and RWMS 9 south. Figure 9.8 is a historical time series plot of the median of the annual averages of these five locations. The median was used in this plot because for small sample sizes the median is a more robust estimator of central tendency than is the mean. Note that this plot has a logarithmic ordinate and that, using this scale, the data have approximately a linear decreasing trend. A linear regression on these data found a very good fit and also found that the medians for 1995 and 1996 were lower than expected. From this regression one can compute the time for tritium in air levels at the NTS to be reduced to one-half; this is four years. Since four years is about a third of the half-life of tritium, the tritium levels at the NTS are decreasing much faster than can be accounted for by radioactive decay alone.

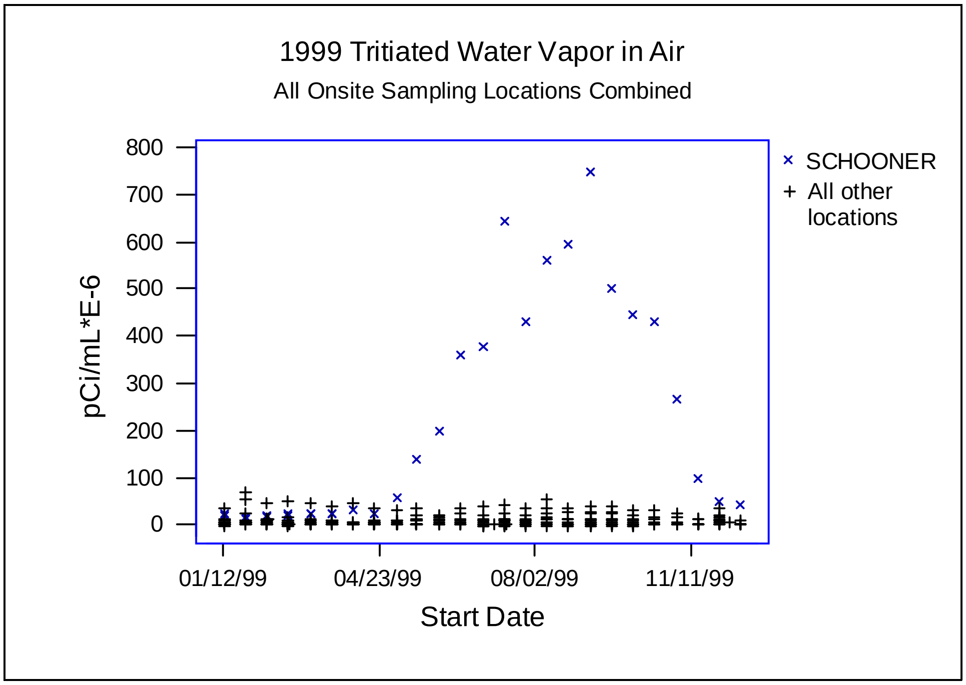

Figure 9.7 Time Series Plot of 1999 Tritium in Air Results

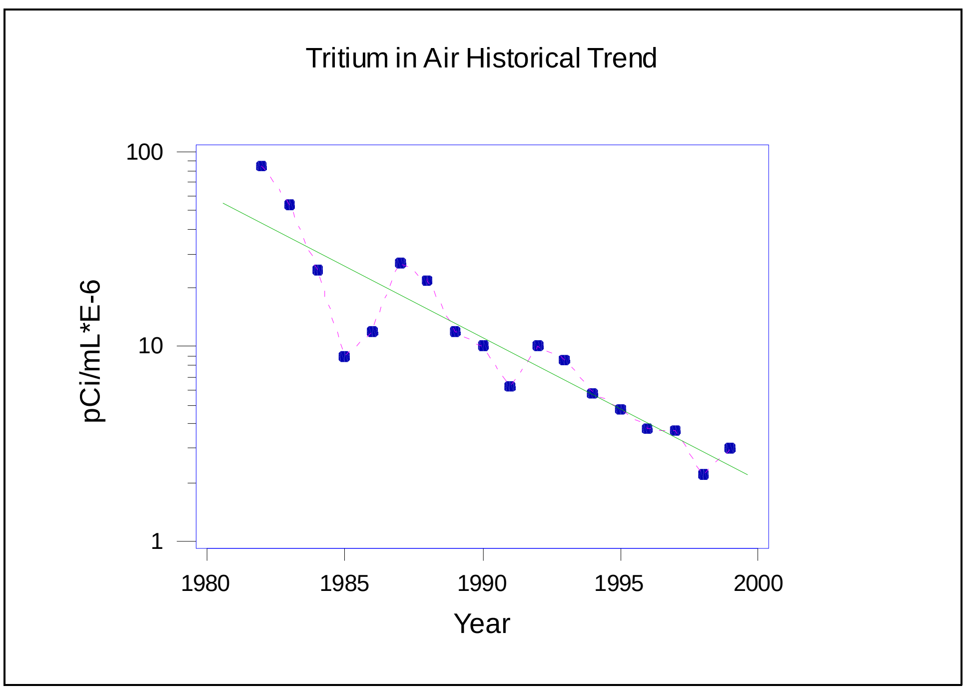

Figure 9.8 Historical Time Series for NTS Tritium in Air

GAMMA EMITTING RADIONUCLIDES IN ONSITE AIR

Naturally occurring radionuclides not in equilibrium at the time of counting, such as ^{208}Tl, ^{212}Pb, ^{214}Pb, ^{212}Bi, and ^{214}Bi, were not included in this report. This leaves no gamma emitting radioisotopes other than those listed in Table 9.6. Of the isotopes listed in this table, ^{137}Cs is man-made; the remaining are naturally occurring and in equilibrium. Descriptive statistics, in units of µCi/mL, for these radionuclides appear in Table 9.6.

GAMMA EMITTING RADIONUCLIDES IN OFFSITE AIR

Beginning in July of 1999, air samples were collected at six locations outside the NTS. This sampling is to provide data for the National Emission Standards for Hazardous Air Pollutants (NESHAP) annual reports. The air samplers used in this program differ from the samplers used for onsite air sampling. The onsite samplers filter air at a rate of 3 cubic feet per minute and the offsite samplers filter air at a rate of 40 cubic feet per minute.

The six offsite locations are in small communities surrounding the NTS. The air samplers are located in Alamo next to the bank, at the Amargosa Valley Community Center, in Beatty adjacent to the post office, in Goldfield adjacent to the post office, at the Indian Springs High School, and in Rachel near the café. Statistics for all these locations combined are given in Table 9.7.

As for the onsite air sampling data, naturally occurring radionuclides not in equilibrium at the time of counting, such as ^{208}Tl, ^{212}Pb, ^{214}Pb, ^{212}Bi, and ^{214}Bi, were not included in this report; this leaves no gamma emitting radioisotopes other than those listed in Table 9.7. Of the isotopes listed in this table, ^{137}Cs is man-made; the remaining are naturally occurring and in equilibrium. Descriptive statistics, in units of µCi/mL, for these radionuclides appear in Table 9.7.

9.2 THERMOLUMINESCENT DOSIMETER DATA

Thermoluminescent dosimeters (TLDs) were placed at 85 monitoring locations on the NTS during 1999. The dosimeters are exchanged quarterly and processed at the Bechtel Nevada Dosimetry Laboratory in Mercury, Nevada. Table 9.8 list the annual total mR/yr for each location. Typically TLDs are exchanged during the first week of each calendar quarter. It takes several work days to exchange all the TLDs, so the exposure duration for each location varies from one quarter to the next. The median exposure in 1999 was 98 days. The range of TLD exposures in 1999 was from 83 to 112 days.

For convenience, TLD locations are divided into four classes. Boundary locations are close to the perimeter of the NTS. Background locations are known to have no man-made radionuclide inventory. Operational locations are adjacent to stored radioactive materials. In 1999, the operational locations included the Areas 3 and 5 RWMS locations and the Decontamination Facility locations. The remaining TLDs are in the environmental monitoring class. Since the boundary locations were established in 1990, there have been no statistically significant differences in annual TLD exposure rates between the boundary locations and the background locations. Thus, the boundary locations are now included within the background class of locations.

Atypical values or outliers were identified, from probability plots and histograms of the data and subsets of the data, as data points plotting at some distance from most of the other data points in that subset. This process identified two distinct groups of TLD data values that have different statistical distributions. The group of non-atypical TLD sampling locations has data values with a normal statistical distribution and a mean value of 118 mR/yr, an upper limit of about 175 mR/yr. The second group contains seven data values from the atypical locations. Seven values are too few to establish a statistical distribution, but in previous years, when the operational locations were found to be grouped with the atypical locations, this group had a lognormal distribution. The 1999 atypical values range from 216 to 823 mR/year and have a median of 272 mR/year.

The seven data values that were judged to be atypical are listed in Table 9.9. The last column of this table, the “Area Mean”, gives the average annual exposure for the NTS area with the atypical values deleted. The 1999 atypical values had exposure rates above 200 mR/yr. The list in Table 9.9 is about the same as in previous years, except that RWMS south was not in the 1998 list. The locations in Table 9.9 are mostly in Yucca Flat in places known to be contaminated by early atmospheric testing of nuclear devices. The SEDAN west location is in the throw out from the crater. The tunnel ponds contain products from the nuclear tests performed within the tunnels.

The average 1999 exposure from the environmental, background, and boundary locations was 118 mR/yr. From 1994 to 1998 the NTS average exposures ranged from 117 to 128 mR/yr. The generally accepted value for worldwide background is 120 mR/yr.

A two-way ANOVA was performed on the non-atypical locations data to test for differences among NTS areas and quarters of the year. This analysis found very significant differences among the areas and no differences among quarters. This is the same pattern as has been found in the past several years. A one-way ANOVA was then used to identify the pattern of differences among areas. This analysis found no grouping or clustering of area mean values. When the area means were sorted by magnitude, the pattern seen was a gradual and consistent increase from a low value for Area 23 to the highest value for Area 30.

Area 30 contains one TLD location. It is the boundary station located at the junction of Cat Canyon Road and the road to the BUGGY test site. This location is as close to the west boundary as can now be reached in this region due to washed out roads. This is in a geographic region with high natural radiation levels from prehistoric lava flows. Aerial surveys of this region detect higher than background levels of ^{208}Th. The highest annual exposure of all environmental locations, excluding those mentioned previously at which annual exposures were atypical, is in Area 20 at Stake J-31. This stake is less than a mile north of two cratering tests, PALANQUIN and CABRIOLET.

Film badges were used during early activities on the NTS for ambient gamma exposure monitoring. TLDs replaced the film badges in 1977, with ten monitoring stations (locations) chosen to be near work sites. From 1977 to 1987, the TLDs used were manufactured by the Harshaw Chemical Company. In 1987, a changeover was made to TLDs manufactured by Panasonic. At the end of 1999, there were a total of 85 active TLD locations.

A three-way ANOVA was used to test for differences in mR/yr due to differences among years, differences among operational areas, and differences between location types (Background and Environmental locations with atypical values removed). The data were the annual mR/yr at each location for 1999 and the previous five years. The operational areas and types were included to remove those sources of error from the residual error and thus increase the power of the ANOVA. The results of this analysis were very significant for differences among years and types and no significant differences among areas. A simultaneous inference analysis of the differences among years identified two clusters of annual averages. The first cluster is composed of the data from 1994, 1995, and 1996 and has a mean value of 300 mR/yr. The second cluster contains the data from 1997, 1998, and 1999 and has a mean value of 169 mR/yr. The location types also clustered into two groups. The operational and atypical locations formed one group with a mean of 820 mR/year, and the control, background, and environmental locations formed the second group with a mean of 121 mR/year.

Figure 9.9 is a boxplot of the data by years for the environmental, background, and control locations. Boxplots consist of a box, whiskers, and outliers. A line is drawn across the box at the median. The bottom of the box is at the first quartile, and the top is at the third quartile value of the data. The whiskers are lines that extend from the top and bottom of the box to adjacent values. Adjacent values are the lowest and highest data values that are less than one and one-half times the interquartile range from the ends of the box. Outliers are data values outside the adjacent values and are plotted with an asterisk. Figure 9.9 shows minor differences between years. This figure does not seem to support the ANOVA finding of significant differences between years. However, this figure does not contain the data from operational and atypical locations and an examination of the historical data from these locations shows obvious decreases over the years used in the ANOVA.

9.3 WATER SAMPLE DATA

GAMMA EMITTING RADIONUCLIDES IN WATER

The only non naturally occurring radionuclide found by gamma spectroscopy in NTS water samples was ^{137}Cs. This isotope was found in seven samples and four duplicates. All but one of these are from Area 12 E Tunnel effluent and pond. The presence of non-naturally occurring radionuclides in E Tunnel waters is not surprising, since nuclear experiments formerly occurred within this tunnel. The other location at which ^{137}Cs was detected was the DAF Sewage Lagoon, where a sample collected on April 22 had a concentration of 1.2×10^{-9} µCi/mL. The ^{137}Cs was not detected in a second sample collected on April 29. Descriptive statistics for the E Tunnel data are presented in Table 9.10.

RADIUM IN WATER

Radium concentrations were measured quarterly at ten supply wells in 1999. Water samples from other types of sources are not analyzed for radium. Descriptive statistics

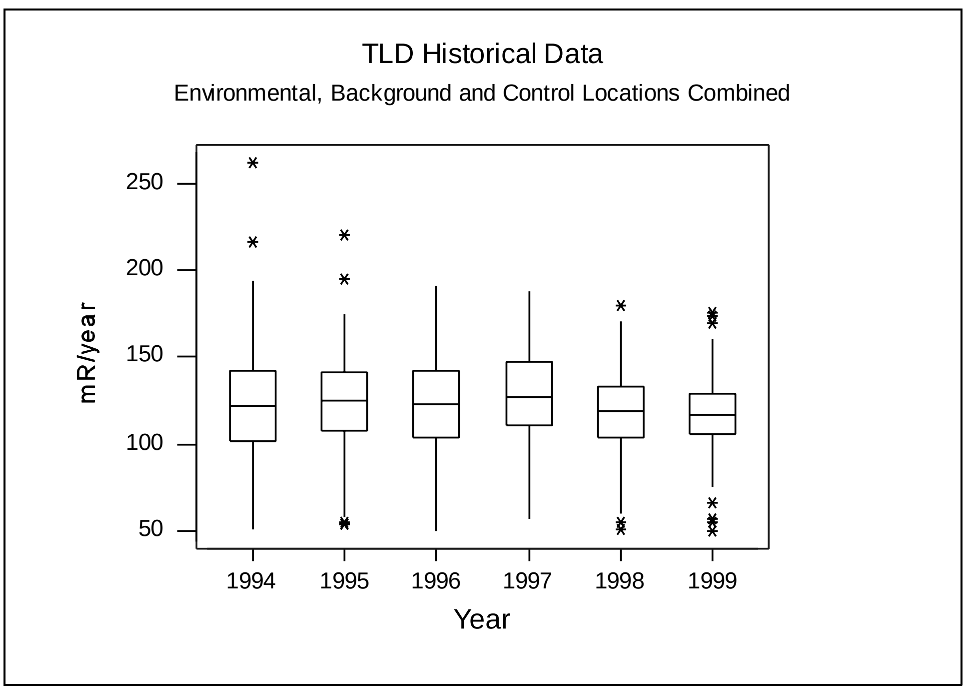

Figure 9.9 Historical Time Series of Boxplots of TLD Exposures

appear in Table 9.11. For ^{226}Ra, 90 percent of the results were less than the MDC, and for ^{228}Ra, 88 percent of the results were less than the MDC. Since 89 percent of all radium results are less than the MDC, only the summary statistics in Table 9.11 were computed.

STRONTIUM IN WATER

In 1999, ^{90}Sr concentrations were measured in samples from 15 locations on the NTS. An annual sample was collected from 6 tap water locations, 2 containment pond locations, and 7 sewage ponds. A total of 18 ^{90}Sr analyses were performed, including 3 duplicates. Descriptive statistics for each type of sampling location are given in Table 9.12

An examination of the data showed that all results were below the MDC, except the four from the E Tunnel; two samples and two duplicates. Water from inside the E Tunnel, where nuclear experiments formerly occurred, drains as an effluent and then into the pond. Thus, it is not surprising to find non-naturally occurring radionuclides in these waters.

Since all of the ^{90}Sr in water results from all locations excluding the containment ponds are less than the individual MDC, and 28 percent of those results are negative, any statistical analyses or further data descriptions are unreasonable. These data simply show, that except for the containment ponds, no ^{90}Sr was detected in NTS water samples.

URANIUM IN WATER

In 1998, the NTS's "Routine Radiological Environmental Monitoring Plan" (RREMP) was developed (DOE 1998a). This plan was published in December 1998. It contains no requirements for monitoring uranium in water; thus, uranium in water analyses were discontinued at the beginning of 1999.

GROSS ALPHA IN WATER

Two new types of wells were sampled in 1999; the Aquifer Monitoring Wells and the Underground Testing Area Wells (UGTA). These were added to comply with the RREMP. These wells were chosen to monitor the groundwater in the vicinity of underground nuclear testing areas. The aquifer monitoring is mostly a new program. UGTA is an ongoing effort of the Environmental Restoration program.

Gross alpha levels in water for 1999 were measured quarterly at 10 water supply wells, and annually at 2 containment ponds, 12 aquifer monitoring wells, 7 underground testing area wells, and 9 sewage ponds. Tap water samples were collected for alpha analysis at six locations. The sampling frequency varied by location from quarterly to annually. Descriptive statistics by location and type are given in Tables 9.13 and 9.14. The statistics for supply wells and tap water locations combined are approximately the same as those reported for 1996, 1997, and 1998. For the supply wells and tap waters combined, all results are positive and 20 percent are less than the MDC.

Figure 9.10 plots the alpha levels by sampling date in 1999 and type of location. This time series plot shows, that in general, the containment pond concentrations are higher than the other water types. There are no interesting time dependent patterns. The well and tap water data for each quarter are approximately uniformly spread over a range of zero to approximately 15×10^{-9} µCi/mL. The aquifer monitoring well data were left out of Figure 9.10. These data contain a few high values that would increase the range of the ordinate and thus obscure the patterns seen in this figure. The statistics for the aquifer monitoring wells are skewed by the 2120.0×10^{-9} µCi/mL sample from well UE-6e. This well produces muddy water samples so the results may be influenced by particulate matter.

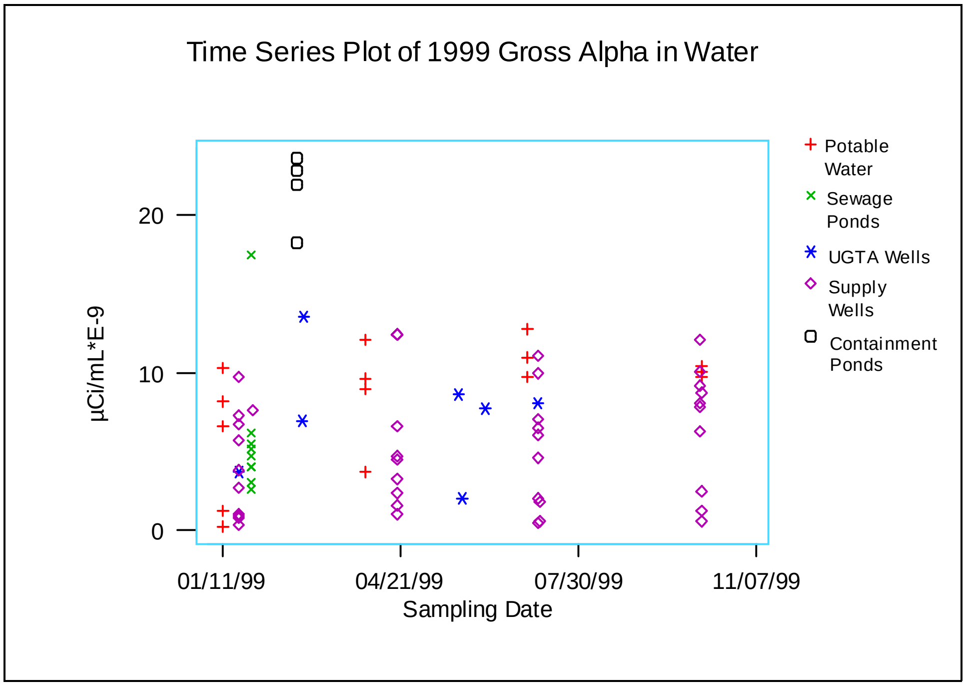

Figure 9.10 Time Series Plot of 1999 Gross Alpha in Water

ANOVA procedures are the statistical methods of choice to analyze the gross alpha in water data for significant differences among sampling locations and types of locations. These procedures require that the residuals have a normal statistical distribution. The residuals from the analyses discussed in the following paragraphs were checked for normality using probability plots, and they were found to have the required normal distribution if the data are transformed using logarithms.

The most appropriate ANOVA for the gross alpha in water data is a three-way analysis with factors of sampling location, type of location (wells or tap water end points), and quarter of the year in which the sample was collected. The locations are nested within the types, and these factors are crossed with the quarter factor. The data are rank deficient for such an analysis because of unbalanced nesting and empty cells due to the fact that many wells are sampled only annually. A two-way ANOVA can be done, predicting the logarithm of the results by water type and location nested within water type. This analysis found a significant difference among sampling locations and also significant differences among types of locations. A Tukey's simultaneous inference analysis found that the water types clustered into two groups: the containment ponds and aquifer monitoring wells formed one group, and the potable water, UGTA wells, sewage ponds, and supply wells formed the second group. The differences between the members of each group are not statistically significant.

The use of logarithms of the data values reduces the influence of the high values from the aquifer monitoring wells on the statistical results. A probability plot of the logarithms of all the data indicated that the gross alpha data set has a lognormal distribution. Thus using the logarithmic transformation of the data in the ANOVA is the appropriate thing to do.

The statistically significant differences of the water sampling locations does not imply that there are health physics concerns with the levels of gross alpha in the NTS drinking waters. The EPA drinking water limit for gross alpha is 15 × 10^{-9} µCi/mL, and all the drinking water and supply well averages are below this limit, as shown in Table 9.13. The probable causes of the gross alpha activity in these waters is the natural radium isotopes ^{226}Ra and ^{228}Ra.

Gross alpha measurements in tap water were begun in 1984 and data exist from 1984 through 1999 for only two sampling locations: the cafeterias in Areas 6 and 23. The Area 23 Cafeteria is also called the Mercury Cafeteria. Figure 9.11 is a time series plot of the annual averages from these two locations. This figure also contains a locally weighted scatterplot smoother line which shows the overall general trend in the data. This figure shows that the Area 6 Cafeteria gross alpha levels are slightly higher than the Area 23 Cafeteria levels and that there is a slight trend of increasing levels over the past 16 years at these two locations.

GROSS BETA IN WATER

Gross beta concentrations in water were measured at the same locations as gross alpha, for a total of 43 sampling locations. For gross beta, the supply wells, potable waters, sewage lagoons, and containment ponds were sampled quarterly. Descriptive statistics are presented in Tables 9.15 and 9.16. The values for the aquifer monitoring wells are skewed by a high value of 1,190 µCi/mL × 10^{-9} at UE-6e. As mentioned in the previous section, this well produces muddy water samples. The values in the table for the containment pond statistics are about an order of magnitude higher than the values from the wells and tap waters. This is to be expected since the containment ponds were constructed to contain the effluents from nuclear experiments performed inside a tunnel, and thus have a more concentrated source of radioactivity than other surface waters. The median MDC for all sampling locations and all sample collection dates is 1.29 × 10^{-9} µCi/mL. All sample results are positive (greater than zero) and 98 percent exceeded the individual MDCs. Figure 9.12 presents a time series plot of the 1999 gross beta in water results for supply wells and tap water end points.

Probability plotting was used to determine that the 1999 gross beta in water data have a lognormal statistical distribution, as was determined for gross beta in water results in previous years. An ANOVA was run using the logarithms of the results as the dependent variable, and quarter of sample collection, water type, and sampling location nested within water type as predictors. The UGTA and aquifer monitoring wells were not used in this analysis. They have data for only one quarter and they have obviously higher gross beta concentrations, as is shown in Tables 9.15 and 9.16. This analysis found no differences among the quarter of the year that samples were collected and very significant differences among the types of sampling locations and also very significant differences among locations. A Tukey’s simultaneous inference analysis on the water types found that the potable water and supply well locations formed a single group, the sewage ponds are a second group, and the containment ponds are a third group of locations.

A one-way ANOVA using the logarithms of the results and sampling location was then used to determine the pattern of differences among the locations. This analysis found very significant differences between sampling locations but did not clearly identify the types of locations. When the locations were sorted on the magnitude of the location means, a gradual increase from the lowest mean to the highest is seen, and the groupings found by the Tukey’s analysis have substantial overlap.

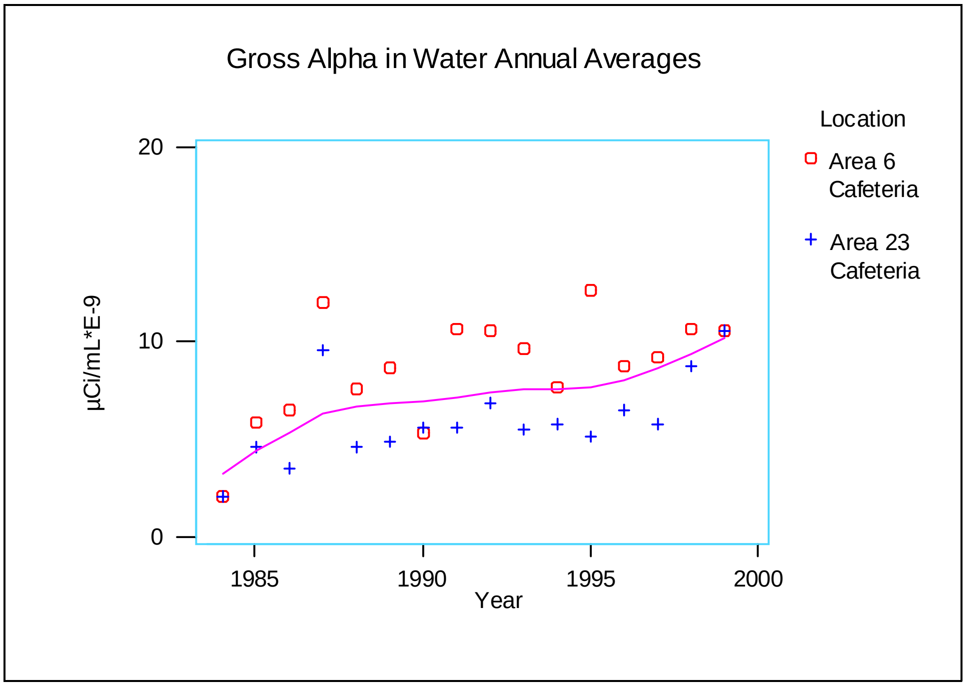

Figure 9.11 Historical Time Series for Gross Alpha in Water

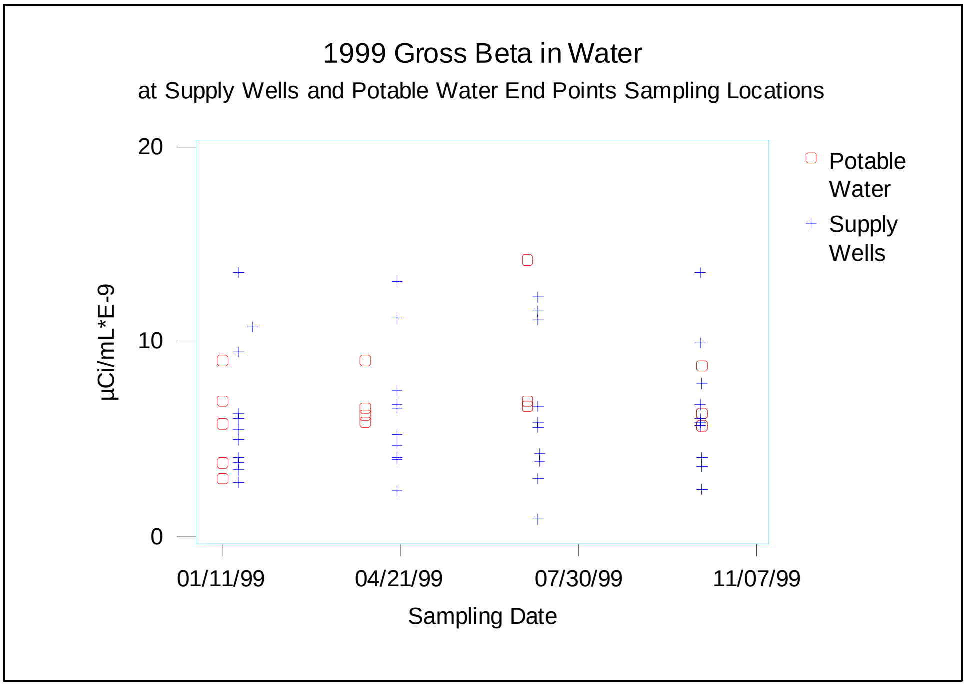

Figure 9.12 Time Series Plot of 1999 Gross Beta in Water

Gross beta in water measurements began in 1964, and data exist from 1964 through 1999 for only four sampling locations: the Area 6 Cafeteria, Area 23 Cafeteria (also called the Mercury Cafeteria), Well C-1, and Well 5C. Figures 9.13 and 9.14 present historical time series plots for these cafeterias and wells. In general, historical trends for levels of gross beta in water are not as clear as those of gross beta in air. Underground waters, such as samples from wells, would not have been affected by atmospheric nuclear testing. Gross beta in air shows declining levels since 1970, about the time atmospheric testing ended. No such trend is evident in the water data. There are obvious differences among sampling locations, but no long term trends are evident. There is a possible short term trend seen in Figure 9.13 for the tap water end points. Note that before 1996, the gross beta concentrations at the Area 6 Cafeteria were always higher than at the Area 23 Cafeteria. For 1996-1999, this pattern is reversed.

Except for the E Tunnel sampling locations, the gross beta and gross alpha activity in the water is probably due to naturally occurring radionuclides, and would be expected to be relatively constant over time at any given location but vary among locations because of local geological structure. This is the situation that has been observed at the NTS.

PLUTONIUM IN WATER

Water samples for ^{238}Pu and $^{239+240}$Pu measurement were collected in 1999 from nine supply wells, six tap water locations, eight sewage lagoons, two containment ponds, nine aquifer monitoring wells, and six UGTA wells. Annual samples were collected from all wells. Quarterly samples were collected from the sewage ponds and containment ponds. Three of the tap water locations were sampled quarterly and three annually. Descriptive statistics for each sampling location sampled quarterly and each sample type sampled annually for ^{238}Pu are given in Table 9.17 and in Table 9.18 for $^{239+240}$Pu.

An examination of the ^{238}Pu data and the statistics in Table 9.17 revealed that all concentrations were below the MDC except for the 14 containment pond results. Plutonium in the E Tunnel effluent is known to result from several nuclear experiments that were preformed within that tunnel. Water that seeps into the tunnel picks up contamination within the tunnel then exits the tunnel as effluent and is collected in the containment pond. The concentrations measured from the effluent and containment pond in 1999 are consistent with historical levels at these locations. Excluding the fourteen ^{238}Pu E Tunnel sample values that are above their MDC, 79 percent of the values are less than zero, and 82 percent of the values were within one standard deviation of zero. This situation indicates that the measurements represent only randomness in the analytical procedures, and no ^{238}Pu was actually found in the samples except at the E Tunnel. Thus, no further statistical analyses were performed.

$^{239+240}$Pu concentrations in water were measured using the same samples as were used for ^{238}Pu; thus, the same sampling pattern applies. The results were also similar. All but one of the results was below the MDC, except those from the E Tunnel containment ponds. $^{239+240}$Pu levels in the effluent and containment ponds are known to be elevated for the same reason ^{238}Pu levels are elevated. Again excluding the E Tunnel data, 71 percent of the values were less than zero; 56 percent of these results are within one standard deviation of zero; and 97 percent were within two standard deviations of zero. As for ^{238}Pu, no further statistical analyses of the $^{239+240}$Pu results were performed.

Annual averages for the plutonium isotopes in water have been reported since 1989. Two representative locations were chosen from each type of water sampling location, except only one containment pond location was used. Except for the Los Alamos National Laboratory (LANL) Sewage Lagoon, the chosen locations have data available for all years since plutonium concentrations were first included in annual reports, and are geographically dispersed within the NTS.

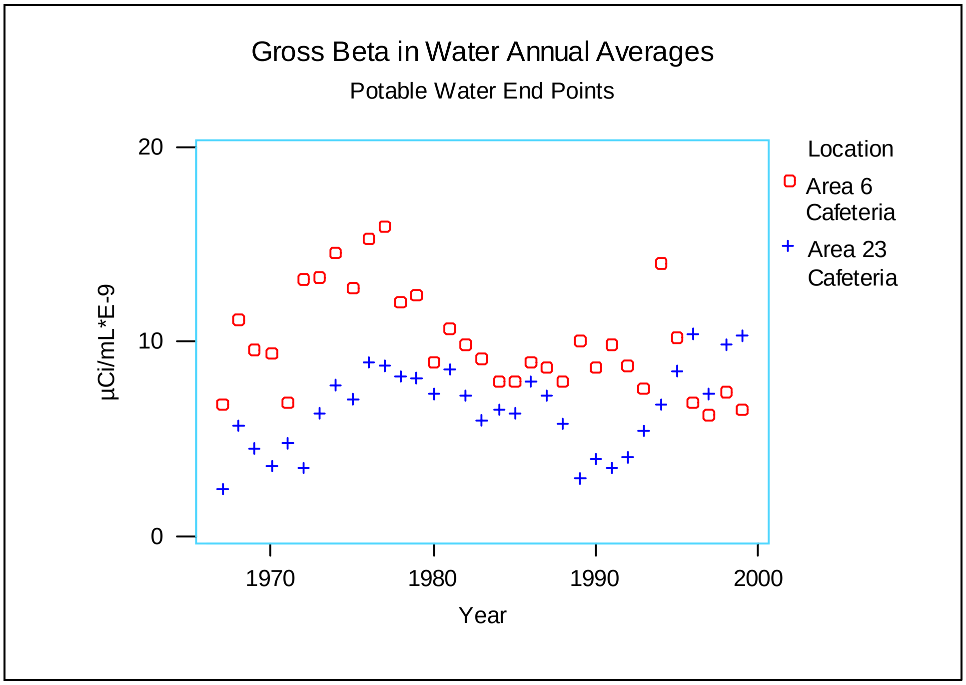

Figure 9.13 Historical Time Series Plot for Tap Water

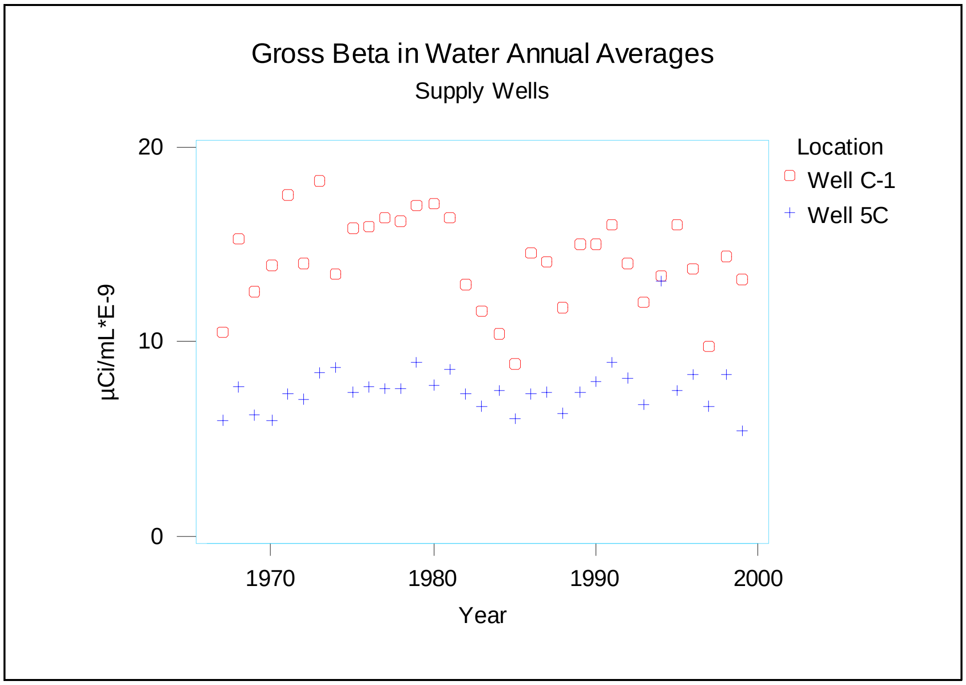

Figure 9.14 Historical Time Series Plot for Supply Wells

The chosen locations are identified in Tables 9.19 and 9.20, which contain the historical annual averages for the last ten years.

Most of the annual averages in these tables are below detection limits or below the MDC, but there are a few notable exceptions. Over the years, the median detection limit for both plutonium isotopes has been approximately 20×10^{-12} µCi/mL. Prior to 1996, the sensitivity of water analyses was reported as detection limits, and in 1996 this was changed to reporting the MDC. Thus it is appropriate to use detection limits when discussing historical plutonium concentrations in water.

The E Tunnel effluents have had highest plutonium levels of both isotopes for all the tabled years. These levels are from known sources, as discussed above. Note that, for both isotopes, the concentrations show a declining trend over time and the 1990 concentrations are about five times the 1999 concentrations for ^{238}Pu and about three times for $^{239+240}$Pu.

The Area 23 sewage lagoon contained both plutonium isotopes above the MDC of in 1996. These observations are discussed in the 1996 Data Report.

TRITIUM IN WATER

Two analytical procedures are used for tritium in water analyses. Most well waters are analyzed using an enriched tritium procedure. The remaining types are analyzed using a conventional tritium procedure. The enriched procedure is capable of measuring substantially lower levels of tritium and it is more accurate (smaller errors) than the conventional method; however, the enriched method is more expensive. Water samples for tritium analysis are usually collected quarterly, and some duplicate analyses were performed. Summary statistics for the samples analyzed using the enriched method are given in Table 9.21 and in Table 9.22 for samples analyzed using the conventional analytical method. In these two tables, if only one sample was analyzed in 1999 for a location, only the sample value and the MDC are listed.

Table 9.21 contains the offsite locations, a location type that is new for 1999. This type consist of 12 potable water locations that are private or public water supplies. They are mostly located in the Amargosa Valley, southwest of the NTS. Since only one sample was collected from each of these locations in 1999, Table 9.21 gives only the summary statistics for all these locations combined.

Examination of Tables 9.21 and 9.22 will reveal that almost all the maximum values are much less than the median MDC. The exceptions are the E Tunnel locations and four of the ten maxima from the UGTA and aquifer monitoring wells analyzed using the enriched method. The concentrations from E Tunnel samples are two orders of magnitude above the MDC and thus show a substantial tritium inventory. Hence, the tritium in water sampling locations can be divided into three groups: the two E Tunnel locations show a substantial inventory of tritium; the four aquifer monitoring and UGTA locations that had results above MDC form the second group which had one sample collected in 1999; and the final group contains all the remaining locations and had maximum values below the MDC.

Concentrations below the MDC represent randomness in the analytical procedure rather than providing information about tritium inventories. Eighty-seven percent of the results reported in Tables 9.21 and 9.22 are less than the corresponding MDC. Thirty-nine percent of the results that are below MDC are also negative. The below MDC data will not be analyzed in this report. Also, the four results from the UGTA and aquifer monitoring wells analyzed using the enriched method will not be analyzed. Four numbers are insufficient for any meaningful statistical analysis.

Tritium in the E Tunnel effluent is known to result from the several nuclear experiments that were performed within that tunnel. Water that seeps into the tunnel picks up contamination within the tunnel then exits the tunnel as effluent and is collected in the containment ponds. The concentrations measured from the effluent and containment ponds in 1999 are consistent with historical levels at those locations.

Tritium in water annual averages are available starting in 1989. In general, annual averages have been below detection limits and MDCs, except for the E Tunnel locations. (Before 1996 detection limits were reported; in 1996 and later, MDCs were reported.) In the 11 years from 1989 through 1999, tritium levels in the E Tunnel Effluent have ranged from 8.3×10^{-4} to 2.2×10^{-3} µCi/mL.

Table 9.1 Descriptive Statistics for 1999 Gross Alpha in Air by Sampling Location, (µCi/mL × 10^{-15})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
NTS Locations							
Area 1, BJY	51	2.42	2.03	1.30	0.19	6.37	1.85
Area 2, 2-1 Substation	61	2.33	1.96	1.60	0.28	8.73	1.85
Area 3, Bunker 3-300	50	2.52	1.92	1.68	0.48	8.50	1.85
Area 3, U-3ah/at North	52	2.43	2.02	1.50	0.58	8.60	1.85
Area 3, U-3ah/at South	62	2.44	2.17	1.50	0.58	8.60	1.85
Area 3, U-3bh North	51	2.79	2.33	1.78	0.58	9.71	1.84
Area 3, U-3bh South	50	2.32	1.89	1.67	-0.48	9.07	1.84
Area 3, Well ER-3-1	53	2.27	2.13	1.44	0.25	7.28	1.85
Area 4, Bunker T-4	50	2.39	2.23	1.60	0.30	8.19	1.85
Area 5, DOD Yard	52	2.09	1.62	1.44	0.29	7.04	1.85
Area 5, RWMS 4 Northeast	63	2.53	2.18	1.63	0.38	8.26	1.84
Area 5, RWMS 9 South	11	1.76	1.83	0.63	0.68	3.04	1.84
Area 5, RWMS 7 West	51	2.77	2.34	1.58	0.02	9.11	1.85
Area 5, Transuranic Bldg. North	51	2.53	2.10	1.61	0.29	7.71	1.85
Area 5, WEF Northeast	51	2.28	1.93	1.39	0.29	7.99	1.85
Area 5, WEF Southwest	51	2.26	1.77	1.55	0.38	8.07	1.85
Area 6, Yucca	64	2.23	1.92	1.49	0.20	8.90	1.85
Area 7, UE-7ns	48	1.99	1.63	1.28	0.39	6.68	1.85
Area 9, Bunker 9-300	62	4.64	3.47	3.72	0.93	21.80	1.85
Area 10, SEDAN north	51	2.41	2.22	1.37	0.48	6.92	1.85
Area 15, EPA Farm	63	2.53	2.03	1.74	0.48	6.92	1.85
Area 18, LITTLE FELLER 2 North	51	2.08	1.88	1.30	0.02	6.97	1.85
Area 20, CABRIOLET	64	2.07	1.98	1.32	0.10	7.41	1.85
Area 20, SCHOONER	54	2.14	1.97	1.34	-0.29	7.39	1.85
Area 25, E-MAD North	62	2.31	2.17	1.58	0.02	8.11	1.91
All NTS locations combined	1329	2.45	2.04	1.75	-0.48	21.80	1.85
NAFR Locations							
Area 13, Project 57	49	2.13	1.81	1.49	0.30	7.98	1.87
Area 52, CLEAN SLATE II	24	2.77	2.43	1.59	0.87	7.30	1.83
Area 52, CLEAN SLATE III	24	3.35	2.65	2.11	0.57	9.07	1.82
Area 52, DOUBLE TRACKS	15	2.08	2.15	0.67	1.04	3.48	1.00
All NAFR locations combined	112	2.52	2.12	1.65	0.30	9.07	1.84

Table 9.2 Descriptive Statistics for 1999 Gross Beta in Air by Sampling Location, ($\mu Ci/mL \times 10^{-15}$)

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
NTS Locations							
Area 1, BJY	51	21.82	21.40	5.68	10.70	37.10	4.05
Area 2, 2-1 Substation	61	22.25	21.80	5.88	10.00	35.40	4.05
Area 3, Bunker 3-300	50	20.41	19.95	5.82	8.75	37.70	4.02
Area 3, U-3ah/at North	52	18.87	18.95	5.36	9.09	33.80	4.05
Area 3, U-3ah/at South	62	19.92	19.45	5.15	8.27	34.40	4.05
Area 3, U-3bh North	51	21.62	21.60	5.79	11.60	34.60	4.05
Area 3, U-3bh South	50	20.23	20.25	5.87	9.04	38.30	4.05
Area 3, Well ER-3-1	53	20.68	20.10	5.97	8.75	38.70	4.05
Area 4, Bunker T-4	50	21.65	21.40	5.73	11.50	35.90	4.05
Area 5, DOD Pad	52	21.04	19.95	6.29	8.80	39.70	4.05
Area 5, RWMS 4 Northeast	63	22.36	21.60	6.04	11.20	38.60	4.03
Area 5, RWMS 9 South	11	18.85	18.70	3.26	13.20	24.40	4.05
Area 5, RWMS 7 West	51	21.71	20.90	6.61	9.66	40.00	4.03
Area 5, Transuranic Bldg. North	51	23.27	22.00	7.43	6.17	41.80	4.03
Area 5, WEF Northeast	51	22.09	21.70	6.66	8.51	40.00	4.04
Area 5, WEF Southwest	51	21.70	21.00	6.82	8.03	42.20	4.03
Area 6, Yucca	64	22.25	21.80	6.38	11.50	39.80	4.05
Area 7, UE-7ns	48	21.15	20.90	5.89	8.70	35.90	4.06
Area 9, Bunker 9-300	62	20.52	20.80	5.95	9.08	36.00	4.05
Area 10, SEDAN north	51	22.00	21.70	5.83	9.60	36.00	4.03
Area 15, EPA Farm	63	21.28	20.80	6.45	7.89	36.80	4.00
Area 18, LITTLE FELLER 2 North	51	20.12	20.20	6.02	10.10	36.50	4.02
Area 20, CABRIOLET	64	19.49	19.10	5.73	4.47	33.00	4.03
Area 20, SCHOONER	54	20.58	19.80	5.81	8.85	38.60	4.02
Area 25, E-MAD North	62	20.79	19.75	6.50	10.20	37.90	4.01
All NTS locations combined	1329	21.13	20.70	6.10	4.47	42.20	4.04
NAFR Locations							
Area 13, Project 57	49	14.25	13.70	4.04	5.90	27.00	4.00
Area 52, CLEAN SLATE II	24	17.89	17.25	5.05	10.20	30.30	3.43
Area 52, CLEAN SLATE III	24	22.16	20.10	7.17	13.90	37.10	3.42
Area 52, DOUBLE TRACKS	15	16.66	17.10	3.62	8.41	23.10	2.20
All NAFR locations combined	112	17.05	16.05	5.82	5.90	37.10	3.91

Table 9.3 Descriptive Statistics for 1999 ^{238}Pu in Air by Sampling Location, (µCi/mL × 10^{-18})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
NTS Locations							
Area 1, BJY	12	0.27	-0.61	1.75	-1.09	3.74	11.10
Area 2, 2-1 Substation	14	0.26	-0.46	1.27	-1.06	3.25	10.35
Area 3, Bunker 3-300	12	1.87	1.11	2.87	-0.90	7.19	9.94
Area 3, U-3ah/at North	12	2.37	1.22	3.02	-0.90	8.92	9.43
Area 3, U-3ah/at South	14	1.57	1.33	1.86	-0.93	5.23	10.45
Area 3, U-3bh North	12	-0.51	-0.76	0.95	-1.09	2.46	10.65
Area 3, U-3bh South	12	0.04	-0.59	1.53	-0.91	4.48	9.62
Area 3, Well ER-3-1	11	-0.66	-0.57	0.18	-1.05	-0.42	8.72
Area 4, Bunker T-4	12	8.34	4.73	9.78	1.01	29.40	9.91
Area 5, DOD Yard	12	0.22	-0.41	1.10	-0.77	2.70	9.62
Area 5, RWMS 4 Northeast	14	0.07	-0.58	2.49	-0.87	8.72	9.27
Area 5, RWMS 9 South	3	-0.68	-0.39	0.56	-1.33	-0.33	19.10
Area 5, RWMS 7 West	12	-0.43	-0.61	0.64	-1.00	1.51	10.13
Area 5, Transuranic Bldg. North	12	-0.65	-0.61	0.18	-0.99	-0.42	9.76
Area 5, WEF Northeast	12	-0.09	-0.69	1.76	-1.19	5.19	11.10
Area 5, WEF Southwest	12	0.10	-0.41	0.94	-0.86	1.46	10.10
Area 6, Yucca Complex	15	0.23	-0.49	1.26	-1.07	2.26	11.00
Area 7, UE-7ns	12	-0.40	-0.60	0.62	-1.03	1.30	9.95
Area 9, Bunker 9-300	14	14.28	13.75	8.58	2.08	27.30	9.22
Area 10, SEDAN North	12	3.45	2.85	2.70	-0.67	9.38	10.75
Area 15, EPA Farm	15	-0.12	-0.62	1.02	-1.15	1.65	11.70
Area 18, LITTLE FELLER 2 North	12	-0.37	-0.58	0.58	-0.83	1.06	9.19
Area 20, CABRIOLET	15	0.99	0.33	2.57	-1.28	7.94	11.10
Area 20, SCHOONER	12	2.09	2.99	2.23	-1.40	4.54	9.73
Area 25, E-MAD North	15	-0.37	-0.71	0.76	-1.11	1.19	10.40
All NTS locations combined	310	1.37	-0.50	4.50	-1.40	29.40	10.15
NAFR Locations							
Area 13, Project 57	12	1.92	-0.58	6.65	-0.99	22.70	10.55
Area 52, CLEAN SLATE II	7	0.75	1.23	1.43	-0.91	2.83	9.79
Area 52, CLEAN SLATE III	8	-0.52	-0.69	0.77	-1.16	1.24	10.02
Area 52, DOUBLE TRACKS	4	0.31	0.30	1.06	-0.80	1.46	11.55
All NAFR locations combined	31	0.82	-0.51	4.23	-1.16	22.7	10.50

Table 9.4 Descriptive Statistics for 1999 $^{239+240}Pu$ in Air by Sampling Location, (µCi/mL × 10^{-18})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
NTS Locations							
Area 1, BJY	12	47.59	29.20	60.78	6.82	231.00	9.95
Area 2, 2-1 Substation	14	18.32	4.75	35.36	-0.65	132.00	10.25
Area 3, Bunker 3-300	12	139.27	77.70	120.89	9.46	382.00	9.88
Area 3, U-3ah/at North	12	214.92	204.50	113.84	48.80	492.00	9.54
Area 3, U-3ah/at South	14	182.60	147.50	108.14	42.30	376.00	10.45
Area 3, U-3bh North	12	62.15	47.80	54.11	12.20	217.00	10.55
Area 3, U-3bh South	12	57.60	50.65	45.43	1.17	169.00	9.62
Area 3, Well ER-3-1	11	5.50	2.88	5.39	0.94	19.00	8.72
Area 4, Bunker T-4	12	59.12	43.35	40.92	19.10	127.00	9.79
Area 5, DOD Yard	12	3.59	0.53	9.33	-0.77	32.40	9.54
Area 5, RWMS 4 Northeast	14	32.95	2.67	107.30	-5.33	405.00	9.27
Area 5, RWMS 9 South	3	1.71	-0.47	4.47	-1.25	6.86	18.80
Area 5, RWMS 7 West	12	4.10	1.59	5.26	-0.66	15.10	10.13
Area 5, Transuranic Bldg. North	12	4.42	1.38	6.30	0.94	23.10	9.69
Area 5, WEF Northeast	12	5.69	1.09	10.09	-0.88	32.10	11.00
Area 5, WEF Southwest	12	7.29	1.30	14.03	-0.64	44.10	10.10
Area 6, Yucca Complex	15	20.79	12.50	20.17	2.09	62.10	10.80
Area 7, UE-7ns	12	13.62	13.40	13.82	1.81	52.80	9.95
Area 9, Bunker 9-300	14	1339.93	1205.00	709.18	335.00	2490.00	8.83
Area 10, SEDAN North	12	45.00	37.35	26.58	11.40	99.90	10.65
Area 15, EPA Farm	15	11.09	8.92	10.59	1.07	43.70	11.50
Area 18, LITTLE FELLER 2 North	12	8.93	6.39	9.62	1.06	33.80	9.11
Area 20, CABRIOLET	15	2.58	1.10	3.72	-1.20	9.51	11.10
Area 20, SCHOONER	12	11.95	1.88	23.18	-0.64	65.10	9.58
Area 25, E-MAD North	15	6.20	1.40	11.60	-1.04	38.90	10.20
All NTS locations combined	310	99.80	10.10	315.80	-5.33	2490.00	10.05
NAFR Locations							
Area 13, Project 57	12	141.18	8.56	423.00	1.52	1480.00	10.65
Area 52, CLEAN SLATE II	7	119.14	129.00	70.18	33.60	223.00	10.20
Area 52, CLEAN SLATE III	8	7.19	2.39	12.00	-0.80	35.40	10.22
Area 52, DOUBLE TRACKS	4	1.54	1.95	1.68	-0.75	3.00	11.70
All NAFR locations combined	31	83.60	6.80	265.90	-0.80	1480.00	10.80

Table 9.5 Descriptive Statistics for 1999 Tritium in Air by Sampling Location, (pCi/mL × 10^{-6})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
NTS Locations							
Area 1, BJY	30	2.98	1.44	4.48	-1.29	19.90	2.72
Area 5, RWMS 4 Northeast	25	4.30	2.97	3.73	0.66	15.30	2.41
Area 5, RWMS 7 West	32	1.69	1.33	3.00	-1.84	11.90	3.06
Area 5, RWMS 9 South	31	1.61	0.79	2.53	-0.92	10.30	2.53
Area 5, RWMS Bldg. 5-6 Rm. 4	18	10.21	8.34	5.66	2.04	22.90	2.91
Area 5, RWMS GCD Trailer	18	29.73	32.55	17.64	4.47	70.20	2.79
Area 5, WEF Northeast	30	3.16	1.02	9.50	-0.61	52.10	2.23
Area 5, Well 5B	31	0.12	0.06	0.89	-2.30	1.88	2.66
Area 6, Decontamination Facility	3	3.42	3.87	1.05	2.22	4.16	2.72
Area 10, SEDAN north	31	15.62	10.20	12.05	1.49	40.80	2.46
Area 12, E Tunnel Pond	21	19.80	21.00	15.18	2.63	54.40	2.16
Area 12, Stake T-18	20	0.28	0.12	0.88	-2.09	2.27	2.49
Area 15, EPA Farm	32	10.57	9.79	4.15	3.76	27.00	3.20
Area 20, SCHOONER	31	201.57	50.70	233.24	12.00	749.00	2.25
All NTS locations combined	353	24.42	3.50	88.21	-2.30	749.00	2.54
All NTS locations except SCHOONER combined	322	7.37	2.21	11.20	-2.30	70.20	2.59
Offsite Locations							
Amargosa Valley	8	3.79	0.25	10.29	-0.58	29.20	2.24
Indian Springs	8	3.86	0.49	5.32	-0.53	11.30	2.31
All offsite locations combined	16	3.83	0.44	7.91	-0.58	29.20	2.24

Table 9.6 Descriptive Statistics for Radionuclides Detected by Gamma Spectroscopy in Onsite Air Samples in 1999, (µCi/mL × 10^{-15})

Nuclide	Number of Samples Containing	Mean	Median	Standard Deviation	Minimum	Maximum	Percent Result > MDC
^{7}Be	311	206.6	208.0	39.2	100.0	287.0	100
^{137}Cs	52	0.909	0.918	0.227	0.522	1.43	14
^{228}Th	12	2.06	2.12	0.540	1.01	2.88	75
^{235}U	4	44.0	4.72	40.0	2.69	164.0	25
^{238}U	11	112.7	122.0	35.6	35.2	163.0	36

Table 9.7 Descriptive Statistics for Radionuclides Detected by Gamma Spectroscopy in Offsite Air Samples in 1999, (µCi/mL × 10^{-15})

Nuclide	Number of Samples Containing	Mean	Median	Standard Deviation	Minimum	Maximum	Percent Result > MDC
^{7}Be	154	159.5	166.5	39.6	60.7	239.0	100
^{137}Cs	10	0.303	0.242	0.169	0.199	0.757	20
^{228}Th	5	16.1	14.9	5.96	9.39	25.6	100
^{235}U	1	59.7					0
^{238}U	6	37.9	38.7	8.5	25.6	48.1	0

Table 9.8 1999 TLD Gamma Exposure Rates - mR/yr

Sampling Location	Annual Total	Sampling Location	Annual Total
Area 1, BJY	91	Area 7, Reitman Seep	117
Area 1, Sandbag Storage Hut	108	Area 8, Stake K-25	100
Area 1, Stake C-2	112	Area 8, Road 8-02	121
Area 1, 1-300 Bunker	121	Area 8, Stake M-152	161
Area 2, Stake M-140	129	Area 9, 9-300 Bunker	119
Area 2, Stake N-8	726	Area 9, Papoose Lake Road	76
Area 2, Stake L-9	174	Area 9, V and G Road Junction	106
Area 2, Stake TH-58	88	Area 9, Crater U-9cw	94
Area 3, Stake OB-20-N, End of 3B Road	81	Area 10, SEDAN West	272
Area 3, LANL Trailers	108	Area 10, SEDAN East Visitors Box	130
Area 3, Stake A-6.5	141	Area 10, Circle and L Road	112
Area 3, RWMS North	116	Area 10, Gate 700 South	125
Area 3, RWMS East	141	Area 11, Stake A-21	122
Area 3, RWMS South	463	Area 12, T Tunnel No. 2 Pond	242
Area 3, RWMS West	121	Area 12, Upper N Pond	122
Area 3, U-3co North	216	Area 12, Upper Haines Lake (E Tunnel)	117
Area 3, U-3co South	153	Area 12, Gold Meadows	128
Area 3, Well ER-3-1	119	Area 15, EPA Farm	106
Area 3, RWMS Center	154	Area 15, Substation U15E	90
Area 4, Stake A-9	823	Area 18, Stake A-83	135
Area 4, Stake TH-48	115	Area 18, Stake F-11	139
Area 4, Stake TH-41	109	Area 19, Stake P-41	156
Area 5, Well 5B	106	Area 19, Stake C-27	149
Area 5, RWMS Northeast Corner	112	Area 19, Stake P-77	158
Area 5, RWMS Northwest Corner	120	Area 19, Stake R-26	152
Area 5, RWMS Southwest Corner	114	Area 19, Gate 19-3P, Kawich Canyon	152
Area 5, RWMS South Gate	106	Area 20, Stake J-31	176
Area 5, RWMS East Gate	136	Area 20, Stake J-41	128
Area 5, 3.3 Mi Southeast of Aggregate Pit	57	Area 20, Stake LC-4	156
Area 5, WEF West	123	Area 20, Stake A-118	142
Area 5, WEF South	123	Area 22, Army Well No. 1	75
Area 5, WEF East	117	Area 23, Building 650 Dosimetry	55
Area 5, WEF North	114	Area 23, Building 650 Roof	50
Area 5, Building 5-31	105	Area 23, Post Office	66
Area 6, CP-6	87	Area 25, NRDS Warehouse	113
Area 6, Yucca Oil Storage Area	111	Area 25, 25-4P Gate	121
Area 6, Stake OB-11.5	122	Area 25, HENRE	113
Area 6, DAF East	87	Area 25, Jackass Flats at 27 Roads	76
Area 6, DAF West	77	Area 25, Guard Station 510	117
Area 6, Decon Facility Northwest	130	Area 25, Yucca Mountain	127
Area 6, Decon Facility Southeast	124	Area 27, Cafeteria	126
Area 7, 7-300 Bunker	265	Area 30, Cat. Can. Rd at Buggy Turnoff	170
Area 7, Stake H-8	127		

Table 9.9 Listing of Atypical TLD Data Values for 1999

Sampling Location	Annual Total mR/yr	Area Mean mR/yr	Sampling Location	Annual Total mR/yr	Area Mean mR/yr
Area 2, Stake N-8	726	131	Area 7, 7-300 Bunker	265	122
Area 3, U-3co North	216	126	Area 10, SEDAN West	272	122
Area 3, RWMS South	463	126	Area 12, T-Tunnel Pond	242	122
Area 4, Stake A-9	823	112			

Table 9.10 Descriptive Statistics for Radionuclides Detected by Gamma Spectroscopy in Water in 1999 ($\mu Ci/mL \times 10^{-9}$)

Nuclide	Number of Samples Containing	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
^{137}Cs	11	182	191	78	49	291	16

Table 9.11 Descriptive Statistics for 1999 Radium in Water, ($\mu Ci/mL \times 10^{-9}$)

Nuclide	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
^{226}Ra	41	1.21	1.05	1.45	-1.47	4.34	3.69
^{228}Ra	41	0.36	0.42	0.33	-0.31	1.18	0.95

Table 9.12 Descriptive Statistics for 1999 ^{90}Sr in Water, ($\mu Ci/mL \times 10^{-9}$)

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Tap Waters	6	-0.02	-0.02	0.08	-0.12	0.07	0.28
Sewage Lagoons	8	0.11	0.12	0.10	-0.06	0.23	0.58
Containment Ponds	4	1.10	1.30	0.67	0.12	1.65	0.52

Table 9.13 Descriptive Statistics for 1999 Gross Alpha in Water by Sampling Location for Locations Sampled Quarterly, (µCi/mL × 10^{-9})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
SUPPLY WELLS							
Area 5, Well 5B	5	5.44	6.32	1.79	2.72	7.05	1.84
Area 5, Well 5C	4	7.83	8.45	4.50	2.02	12.40	1.90
Area 6, Well No. 4	2	7.46	7.46	5.15	3.81	11.10	1.81
Area 6, Well No. 4A	4	8.84	8.63	2.78	5.71	12.40	1.75
Area 6, Well C-1	4	10.48	11.04	2.37	7.33	12.50	3.68
Area 16, Well UE-16D	4	7.36	7.45	2.32	4.76	9.76	2.38
Area 18, Well HTH No. 8	4	0.66	0.57	0.27	0.43	1.05	1.20
Area 22, Army Well No. 1	5	6.02	6.69	2.01	3.28	7.89	1.90
Area 25, Well J-12	4	1.30	1.09	0.82	0.58	2.44	1.53
Area 25, Well J-13	5	1.61	1.64	0.64	0.92	2.52	1.65
All Supply Wells	41	5.52	5.71	3.89	0.43	12.50	1.83
TAP WATER							
Area 1, Building 101	1	3.73					1.99
Area 6, Cafeteria	4	9.97	10.55	2.35	6.67	12.10	1.70
Area 6, Building 6-900	4	9.37	9.41	0.93	8.25	10.40	1.68
Area 12, Ice House	1	0.30					1.05
Area 23, Mercury Cafeteria	4	10.64	10.06	1.47	9.64	12.80	1.77
Area 25, Building 4221	1	1.27					1.30
All Tap Water	15	8.35	9.79	3.75	0.31	12.80	1.70

Table 9.14 Descriptive Statistics for 1999 Gross Alpha in Water by Sampling Location for Locations Sampled Annually, (µCi/mL × 10^{-9})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Containment Ponds	4	21.65	22.35	2.34	18.30	23.60	1.94
Sewage Ponds	9	5.90	4.79	4.49	2.61	17.50	3.43
Aquifer Monitoring Wells	12	213.61	7.50	603.74	0.10	2120.0	1.96
UGTA Wells	7	7.26	7.71	3.70	2.11	13.60	1.81

Table 9.15 Descriptive Statistics for 1999 Gross Beta in Water by Sampling Location, for Locations Sampled Quarterly (µCi/mL × 10^{-9})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
SUPPLY WELLS							
Area 5, Well 5B	5	10.66	11.10	0.91	9.47	11.60	1.23
Area 5, Well 5C	4	5.38	6.54	3.02	0.91	7.53	1.25
Area 6, Well No. 4	2	5.42	5.42	0.60	5.00	5.85	1.25
Area 6, Well No. 4A	4	6.10	9.96	0.46	5.72	6.76	1.22
Area 6, Well C-1	4	13.15	13.35	0.61	12.30	13.60	2.46
Area 16, Well UE-16d	4	6.70	6.69	0.95	5.55	7.88	1.56
Area 18, Well HTH No. 8	4	2.62	2.60	0.29	2.34	2.95	1.22
Area 22, Army Well No. 1	5	6.49	5.64	2.45	4.74	10.80	1.32
Area 25, Well J-12	4	4.02	4.03	0.07	3.92	4.09	1.22
Area 25, Well J-13	5	3.79	3.76	0.32	3.41	4.22	1.22
All Supply Wells	41	6.52	5.85	3.37	0.91	13.60	1.24
TAP WATER							
Area 1, Building 101	1	5.89					1.28
Area 6, Cafeteria	4	6.49	6.61	0.60	5.74	6.98	1.21
Area 6, Building 6-900	4	6.34	6.45	0.40	5.77	6.67	1.21
Area 12, Ice House	1	3.00					1.21
Area 23, Cafeteria	4	10.27	9.07	2.62	8.76	14.20	1.22
Area 25, Building 4221	1	3.77					1.21
All Tap Water	15	7.00	6.57	2.61	3.00	14.20	1.21
CONTAINMENT PONDS							
Area 12, E Tunnel Effluent	7	69.84	70.90	12.86	49.10	87.50	1.27
Area 12, E Tunnel Pond	7	64.89	65.10	3.44	60.30	68.80	1.30
All Containment Ponds	14	67.36	66.55	9.40	49.10	87.50	1.30
SEWAGE LAGOONS							
Area 5, RWMS Sewage	5	31.44	31.70	16.44	15.70	57.90	1.31
Area 6, DAF Sewage	5	23.62	22.10	4.69	19.00	28.70	1.83
Area 6, LANL Sewage	4	43.52	43.60	15.79	27.90	59.00	1.93
Area 6, Yucca Sewage	5	19.46	20.20	2.77	15.50	22.60	1.29
Area 22, Sewage	4	35.31	37.60	20.95	9.52	56.50	1.59
Area 23, Sewage	4	21.13	20.40	20.95	9.52	56.50	1.59
Area 25, Central Sewage	5	20.02	19.20	3.59	17.50	26.20	1.29
Area 25, Reactor Control	3	26.47	24.60	19.27	8.20	46.60	2.44
All Sewage Lagoons	35	27.20	22.30	13.67	8.20	59.00	1.40

Table 9.16 Descriptive Statistics for 1999 Gross Beta in Water by Sampling Location, for Locations Sampled Annually (µCi/mL × 10^{-9})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Aquifer Monitoring Wells	12	127.48	7.30	337.32	0.81	1190.00	1.32
UGTA Wells	7	15.45	6.47	21.62	2.91	63.20	1.29

Table 9.17 Descriptive Statistics for 1999 ^{238}Pu in Water by Sampling Location, (µCi/mL × 10^{-12})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Supply Wells	10	-1.47	-2.06	2.03	-2.36	4.28	20.45
Aquifer Monitoring Wells	11	-1.74	-2.33	2.35	-5.07	3.54	24.30
UGTA Wells	6	-0.09	-0.80	3.54	-3.50	5.18	21.30
Tap Water							
Area 1, Building 101	1	-2.75					20.70
Area 6, Cafeteria	4	-2.99	-2.55	1.56	-5.18	-1.69	21.25
Area 6, Building 6-900	4	-3.07	-2.60	1.83	-5.67	-1.39	21.55
Area 12, Ice House	1	-0.25					24.70
Area 23, Mercury Cafeteria	4	-0.93	-1.71	2.26	-2.68	2.37	19.75
Area 25, Building 4221	1	-4.47					29.90
All Tap Water	15	-2.36	-2.54	1.95	-5.67	2.37	20.70
Sewage Lagoons							
Area 5, RWMS Sewage Pond	3	-0.69	-1.99	2.61	-2.40	2.32	22.40
Area 6, DAF Sewage Pond	4	-1.07	-1.52	1.68	-2.58	1.34	18.35
Area 6, LANL Sewage Pond	3	-0.31	-0.16	1.46	-1.84	1.07	20.00
Area 6, Yucca Sewage Pond	4	-0.83	-0.80	1.80	-2.89	1.15	19.45
Area 22, Sewage Pond	3	-1.39	-2.55	2.36	-2.95	1.33	21.80
Area 23, Sewage Pond	3	1.31	-1.58	5.02	-1.59	7.11	18.70
Area 25, Central Sewage Pond	4	-2.48	-2.59	0.73	-3.25	-1.50	25.75
Area 25, Reactor Control Pond	2	-2.72	-2.72	0.47	-3.05	-2.39	25.35
All Sewage Lagoons	26	-1.01	-1.63	2.30	-3.25	7.11	20.35
Containment Ponds							
Area 12, E Tunnel Effluent	7	335.14	333.00	27.00	293.00	369.00	19.90
Area 12, E Tunnel Pond	7	326.14	316.00	52.02	265.00	425.00	20.00
All Containment Ponds	14	330.64	321.00	40.09	265.00	425.00	19.95

Table 9.18 Descriptive Statistics for 1999 $^{239+240}Pu$ in Water by Sampling Location, (µCi/mL × 10^{12})

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Supply Wells	10	-2.80	-3.74	1.43	-4.44	-1.06	24.80
Aquifer Monitoring Wells	12	3.24	0.79	13.77	-5.31	45.60	27.70
UGTA Wells	5	-0.34	-1.09	5.98	-7.50	9.14	21.00
Tap Water							
Area 1, Building 101	1	-1.39					23.50
Area 6, Cafeteria	4	-3.65	-3.99	2.08	-5.61	-1.02	25.00
Area 6, Building 6-900	4	-3.82	-3.48	2.49	-7.00	-1.34	25.10
Area 12, Ice House	1	5.25					26.40
Area 23, Mercury Cafeteria	4	-2.98	-3.25	1.53	-4.40	-1.03	23.50
Area 25, Building 4221	1	-4.85					30.60
All Tap Water	15	-2.85	-3.00	2.89	-7.00	5.25	23.90
Sewage Lagoons							
Area 5, RWMS Sewage Pond	3	-2.60	-3.32	2.56	-4.72	0.25	25.60
Area 6, DAF Sewage Pond	4	0.56	-0.51	3.52	-2.39	5.64	21.50
Area 6, LANL Sewage Pond	3	-1.30	-2.37	2.99	-3.61	2.08	24.40
Area 6, Yucca Sewage Pond	4	6.20	5.10	9.61	-3.28	17.90	22.70
Area 22, Sewage Pond	3	2.62	3.38	5.22	-2.94	7.41	23.80
Area 23, Sewage Pond	3	1.44	1.52	1.90	-0.51	3.30	21.10
Area 25, Central Sewage Pond	4	-3.09	-3.42	1.42	-4.36	-1.14	28.80
Area 25, Reactor Control Pond	2	8.27	8.27	0.35	8.02	8.52	28.80
All Sewage Lagoons	26	1.22	-0.32	5.50	-4.72	17.90	23.30
Containment Ponds							
Area 12, E Tunnel Effluent	7	2895.71	2920.00	309.89	2350.00	3230.00	22.50
Area 12, E Tunnel Pond	7	2705.71	2680.00	234.23	2380.00	3040.00	22.60
All Containment Ponds	14	2800.71	2800.00	281.71	2350.00	3230.00	22.55

Table 9.19 Historical ^{238}Pu in Water Annual Averages at Selected Locations, (µCi/mL × 10^{-12})

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WELLS										
Area 18, Well HTH No. 8	31.0	2.2	-12.0	4.8	-2.1	-1.7	-3.0	0.4	0.1	-2.1
Area 25, Well J-13	12.0	0.7	-5.0	-6.9	-0.7	-0.4	-2.9	-0.9	-1.8	-2.1
TAP WATER										
Area 6, Cafeteria	44.0	20.1	-2.3	0.0	1.7	2.6	-1.5	0.2	1.1	-3.0
Area 23, Cafeteria	12.0	18.6	5.0	0.0	1.3	1.5	-3.8	-1.1	-0.1	-0.9

Table 9.19 (Historical ^{238}Pu in Water Annual Averages at Selected Locations, [µCi/mL × 10^{-12}], cont.)

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SEWAGE LAGOONS										
Area 6, LANL Sewage					-0.7	5.9	-2.4	-1.7	-0.4	-0.3
Area 23, Sewage Lagoon	-14.5	1.3	-11.4	0.0	-1.3	1.3	13.9	-1.9	-0.1	1.3
CONTAINMENT PONDS										
E Tunnel Effluent	1616.7	732.5	660.0	450.0	687.3	323.0	355.8	388.0	232.5	335.1

Table 9.20 Historical $^{239+240}Pu$ in Water Annual Averages at Selected Locations, (µCi/mL × 10^{-12})

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
WELLS										
Area 18, Well HTH No. 8	-3.0	0.6	7.2	-8.2	2.5	-1.1	-3.5	0.1	-2.8	-3.9
Area 25, Well J-13	7.8	2.6	13.2	-6.9	2.1	-1.6	-1.1	-2.1	-2.5	-1.1
TAP WATER										
Area 6, Cafeteria	19.0	5.8	-0.9	2.3	0.5	0.9	-2.4	-1.8	2.0	-3.0
Area 23, Cafeteria	0.5	2.9	0.1	2.1	0.6	-0.1	-4.1	-2.3	0.0	-3.0
SEWAGE LAGOONS										
Area 6, LANL Sewage					3.2	-1.6	-0.7	7.5	1.2	-1.3
Area 23, Sewage Lagoon	3.5	16.1	1.8	7.1	9.0	5.0	818.9	11.7	0.7	1.4
CONTAINMENT PONDS										
E Tunnel Effluent	9223	9500	6275	4333	5343	5208	2840	3190	2018	2896

Table 9.21 Descriptive Statistics for 1999 Tritium in Water by Sampling Location, (µCi/mL × 10^{-9}) Enriched Analytical Method

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
SUPPLY WELLS							
Area 5, Well 5B	5	2.49	1.77	3.50	-1.95	6.71	13.70
Area 5, Well 5C	4	0.92	-0.47	6.23	-4.49	9.12	12.60
Area 6, Well No. 4	2	-0.51	-0.51	3.87	-3.25	2.23	12.40
Area 6, Well No. 4A	4	-0.28	0.60	7.38	-10.10	7.80	15.85

Table 9.21 (Descriptive Statistics for 1999 Tritium in Water by Sampling Location, [µCi/mL × 10^{-9}] Enriched Analytical Method, cont.)

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
Supply Wells, cont.							
Area 6, Well C-1	4	4.96	4.70	2.74	1.90	8.54	15.70
Area 16, Well UE-16D	4	-0.44	-0.65	1.88	-2.19	1.74	15.25
Area 18, Well HTH No. 8	4	3.02	3.16	2.70	-0.23	5.98	15.15
Area 22, Army Well No. 1	5	0.06	2.11	3.91	-6.42	3.14	12.50
Area 25, Well J-12	4	3.24	2.57	1.45	2.43	5.41	15.25
Area 25, Well J-13	5	0.16	0.85	4.76	-6.78	4.69	14.60
All supply wells combined	41	1.42	2.03	4.15	-10.10	9.12	14.70
AQUIFER MONITORING WELLS							
Area 3, USGS Water Well A	1	668.00					13.70
Area 17, USGS Well HTH-1	5	0.66	-0.15	1.72	-0.97	3.25	16.00
Area 18, UE-18r	2	0.94	0.94	1.30	0.02	1.86	15.55
Area 19, U-19bh	1	62.10					12.50
Area 20, Well PM-1	1	181.00					13.90
All aquifer monitoring wells combined	10	91.63	1.71	210.53	-0.97	668.00	15.55
UGTA WELLS							
Area 5, Well UE-5c	2	2.19	2.19	0.81	1.62	2.76	11.57
Area 6, ER-6-1	1	2.87					16.40
Area 12, ER-12-1	1	27.90					16.00
Area 19, UE-19c Water Well	1	3.42					13.20
Area 20, Well U-20	1	0.67					17.50
All UGTA wells combined	6	6.54	2.82	10.51	0.67	27.90	15.45
POTABLE WATER							
Area 1, Building 101	1	-0.58					16.70
Area 6, Cafeteria	4	-0.74	2.17	8.94	-13.70	6.40	16.00
Area 6, Building 6-900	4	-1.40	-0.64	4.75	-7.83	3.52	14.30
Area 12, Icehouse	1	-1.64					13.90
Area 23, Mercury Cafeteria	4	1.42	4.47	7.08	-9.12	5.87	15.00
Area 25, Building 4221	1	-3.10					15.40
All potable water combined	15	-0.55	0.09	5.88	-13.70	6.40	15.30
All offsite locations	12	2.43	2.61	1.66	-0.51	4.71	15.15

Table 9.22 Descriptive Statistics for 1999 Tritium in Water by Sampling Location, (μCi/mL × 10^{-9}) Conventional Analytical Method

Sampling Location	Number of Samples	Mean	Median	Standard Deviation	Minimum	Maximum	Median MDC
AQUIFER MONITORING WELLS							
Area 1, UE-1q	2	-7.76	-7.76	6.84	-12.60	-2.92	16.15
Area 4, UE-4t #1	1	7.20					20.00
Area 4, UE-4t #2	1	5.09					16.80
Area 4, USGS Test Well D	2	-3.62	-3.62	4.17	-6.57	-0.67	16.80
Area 6, UE-6e	1	14.40					33.70
All aquifer monitoring wells combined	7	0.56	-0.67	9.07	-12.60	14.40	16.80
UGTA WELLS							
Area 2, Water Well 2	1	-4.50					16.50
Area 3, ER-3-2	1	-4.06					16.80
All UGTA wells combined	2	-4.28	-4.28	0.31	-4.50	-4.06	16.65
SEWAGE LAGOONS							
Area 5, RWMS Sewage Pond	5	-58.48	-93.80	217.13	-341.00	248.00	747.00
Area 6, DAF Sewage Pond	5	11.48	-93.80	275.60	-166.00	500.00	799.00
Area 6, LANL Sewage Pond	4	-97.52	-71.10	104.02	-242.00	-5.86	773.00
Area 6, Yucca Sewage Pond	5	-40.30	0.41	166.89	-293.00	153.00	747.00
Area 22, Sewage Pond	4	76.90	60.60	92.77	-17.60	204.00	773.00
Area 23, Sewage Pond	4	63.55	90.60	187.91	-185.00	258.00	773.00
Area 25, Central Sewage Pond	5	-116.31	-124.00	69.64	-182.00	0.45	799.00
Area 25, Reactor Sewage Pond	3	-23.63	0.41	101.51	-135.00	63.70	747.00
All sewage ponds combined	35	-26.21	-41.20	167.77	-341.00	500.00	747.00
CONTAINMENT PONDS							
Area 12, E Tunnel Effluent	7	947286	954000	17356	912000	961000	736
Area 12, E Tunnel Pond	7	937286	944000	13659	914000	953000	736
All containment ponds combined	14	942286	945500	15877	912000	961000	736